NONDESTRUCTIVE ANALYSIS OF SALES GAS LINE PIPE EVIDENCE FROM THE WEST COTE BLANCHE BAY PIPELINE RUPTURE INCIDENT

Prepared For The

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, DC

FEBRUARY 27, 2007

Nondestructive Analysis of
Sales Gas Line Pipe Evidence from the
West Cote Blanche Bay Pipeline Rupture Incident

PN 131454

Prepared for the
National Transportation Safety Board
Washington, DC

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February 27, 2007

EXECUTIVE SUMMARY

Following the rupture of an 8-inch sales gas line in West Cote Blanche Bay, located near Franklin, Louisiana, samples of the pipeline were salvaged and brought to the facilities of Stress Engineering Services, Inc. in Houston, Texas. There, at the request of the National Transportation Safety Board (NTSB), Stress Engineering Services, Inc. performed a series of nondestructive tests and examinations in order to further the NTSB's investigation into the pipeline rupture. The work included visual examination, with and without the aid of low-powered magnification, photography, optical fractography, dimensional measurements, determination of weld and longitudinal fracture locations, visual identification of external coatings, and hardness testing. The objectives were to document the overall condition of the pipe, including fracture and weld locations; identify fracture mechanisms, directions, and origins; inspect for foreign object damage and pre-existing conditions; measure the pipe diameter and wall thickness; measure the hardness of the steel; and visually characterize external coatings.

The rupture produced both a transverse fracture and a longitudinal fracture in the pipeline. The transverse fracture was located approximately 2.1 feet east of a field girth weld located in the section of pipe referred to as the "west portion". The longitudinal fracture extended from the transverse fracture to the east for a distance of approximately 43.4 feet. For most of its length, the longitudinal fracture followed the longitudinal pipe weld.

A variety of features that appeared to have been caused by foreign object damage were observed on the sales gas line, including several substantial dents, scratches, and gouges located near the transverse fracture in the east portion; and scratches, flattening of the pipe, and concrete damage in the west portion. Other scratches, cracks, and spalling in the concrete coating on the west portion could have resulted from foreign object damage or been pre-existing conditions. Other than the fractures and foreign object damage, the east and west portions of the sales gas line appeared to be in good condition. Internal and external corrosion were insignificant.

SCOPE OF THIS REPORT

The scope of this report is limited to the matters expressly covered. This report is prepared for the sole benefit of the National Transportation Safety Board. All recommendations, findings and conclusions stated in this report are based upon facts and circumstances as they existed at the time that this report was prepared. Stress Engineering Services, Inc. (SES) reserves the right to modify any findings and conclusions based on further study or if more information becomes available.

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1.0 INTRODUCTION

On October 12, 2006, Spud Barge Number 106 was operating in the area of an oil and natural gas field located in West Cote Blanche Bay, near Franklin, Louisiana. The field is operated by Gulfport Energy Corporation and is criss-crossed with numerous pipelines of various sizes, some of which are out of service and some that are in service. It was reported that a spud from Barge Number 106 contacted and ruptured an 8-5/8 inch diameter natural gas pipeline called a sales gas line. The pipeline is allegedly owned by Chevron USA Production Co. and Gulfport Energy Corporation and was in service at the time of the incident. Two samples of the ruptured sales gas line and six field lines criss-crossing above the ruptured pipeline were salvaged between November 7 and 17, 2006. The sales gas line samples were brought to Stress Engineering Services, Inc. in Houston, Texas on January 23, 2007 for analysis.

2.0 OBJECTIVE

The National Transportation Safety Board requested that certain nondestructive tests and examinations be performed on the sales gas line samples in order to further their investigation into the pipeline rupture (Appendix A). Specifically, the NTSB requested the following tests and examinations:

- Written and photographic documentation of the overall condition of the pipe and fracture locations including circumferential and longitudinal weld locations and circumferential location of the longitudinal fracture as oriented in the ground.
- Fractographic inspection documenting fracture mechanisms, fracture directions, and fracture origin(s) including written and photographic documentation.
- Written and photographic documentation of any features consistent with foreign object contact, pre-existing conditions, or any other damage affecting the pipe integrity.
- Measured dimensions including wall thickness measurements near the fracture origin(s) and at other locations away from the fracture, inner diameter, and outer diameter.
- Material hardness measurements within the fractured length of pipe.
- Pipe and coating specifications.

The results of these tests and examinations are documented in this report.

3.0 DETAILS OF ANALYSIS

The ruptured sales gas line is reportedly an 8-5/8 inch outside diameter by 0.250-inch nominal wall thickness, API specification 5L, grade X46 steel pipe. It was externally coated with a spiral-wrapped, asphalt-type material followed by concrete coating of all but the field weld joints. The field weld joints were coated with asphalt-type material without subsequent concrete coating.

3.1 Visual Examination and Fractography

Figures 1 and 2 show the east portion of the sales gas line during salvaging. The "east portion" is a section of the sales gas line of approximately 53 feet, 9 inches in length located immediately to the east of the transverse fracture as the pipe was found during salvaging. The "west portion" is a section of the sales gas line of approximately 52 feet, 11 inches in length located immediately to the west of the transverse fracture. Figure 3 shows the west portion during salvaging. Figures 4 and 5 show both sales gas line samples shortly after salvaging.

The rupture event produced both a transverse fracture and a longitudinal fracture in the pipe. The transverse fracture was located approximately 2.1 feet east of a circumferential field girth weld located in the west portion (Figure 6). The longitudinal fracture extended from the transverse fracture to the east for a distance of approximately 43.4 feet (Figure 7). The longitudinal fracture intersected only one field girth weld, which was located approximately 43 feet east of the transverse fracture. The longitudinal fracture did not extend to the west of the transverse fracture into the west portion of the sales gas line.

Before the sales gas line pipe samples were lifted from the bottom of West Cote Blanche Bay, divers tied ropes around the circumference of the samples with the knots positioned at the geometric top of the pipe. Figure 8 shows the knotted rope on the east portion shortly after salvaging. Figure 9 shows the knotted rope on the west portion of the sales gas line. In the laboratory, the east portion was rotated such that the rope knot was at the bottom. Photographs were then taken to show the position of the longitudinal fracture (Figure 10). The longitudinal fracture was located in the vicinity of the geometric bottom of the pipe as it was found following

the rupture. A longitudinal band of minor corrosion was observed on the inside surface of the east portion in the vicinity of the transverse fracture (Figure 11). The minor corrosion most likely resulted from the presence of water inside the bottom of the pipe during service. The minor corrosion is the most likely indicator of the actual geometric bottom of the pipe prior to the rupture. The longitudinal fracture was located approximately 3.75 inches circumferentially from the center of the band of corrosion. If the band of minor corrosion in fact represents the geometric bottom of the pipe prior to the rupture, then the longitudinal fracture in the east portion of the sales gas line was located approximately 3.75 inches circumferentially or 50 degrees above the geometric bottom on the south side of the pipe.

For most of its length, the longitudinal fracture followed the longitudinal pipe weld in the east portion of the sales gas line (Figure 12). The fracture did not follow the longitudinal pipe weld after it crossed the field girth weld that was located near the east end of the fracture and shown in Figure 7. The longitudinal welds were not aligned on either side of the field girth weld.

Figure 13 shows the east end of the west portion of the sales gas line at the transverse fracture. It shows the position of the longitudinal pipe weld in relation to the geometric top of the pipe as it was found following the rupture. This longitudinal weld was located near the geometric bottom of the pipe as it was found after the rupture. The longitudinal fracture did not continue past the transverse fracture into the west portion of the sales gas line. A longitudinal band of minor corrosion, similar to that observed in the east portion, was also observed inside the west portion. The band of minor corrosion is the most likely indicator of the geometric bottom of the pipe prior to the rupture. Figure 14 shows the band of minor corrosion and the location of the longitudinal pipe weld in relation to the band of corrosion. When similar features on the transverse fracture surfaces of the east and west portions of the sales gas line were aligned, the positions of the longitudinal pipe welds and bands of minor corrosion and pitting also aligned. The discrepancy between the positions of the geometric bottom of the pipe, as indicated by the rope knot versus the band of minor internal corrosion, suggests that the pipe rotated slightly during the rupture.

A variety of features consistent with foreign object damage were observed on both portions of the sales gas line. Figure 15 shows several substantial dents, scratches, and gouges located near

the transverse fracture in the east portion. Figure 16 shows a line of abrasions in the field weld joint closest to the transverse fracture in the west portion. The wire-reinforced concrete coating at the transverse fracture in the west portion was significantly damaged (Figures 17 and 18). The wall of the pipe was deformed inward (flattened) in the location of the damaged concrete (Figure 19). The inside diameter of the pipe was measured in this location and was found to be 7.848 inches in line with the flattened side versus 8.250 inches at right angles to this measurement, a difference of 0.402 inch. With the longitudinal welds at the transverse fracture in the east and west portions aligned, the abrasions, concrete damage, and flattening damage to the west portion aligned with the dents, gouges, and scratches on the east portion (Figure 15).

The concrete coating on the west portion exhibited additional features that could have been pre-existing conditions or foreign object damage. They included lines of abrasions on different sides of the pipe (Figure 20), cracks, and spalls (Figures 21 to 23).

Other than the fractures and foreign object damage, the east and west portions of the sales gas line appeared to be in good condition. There was no evidence of significant internal or external corrosion.

3.2 Optical Fractography

The fracture surfaces were examined visually and with the aid of magnifying glasses of up to 10X magnification. Most of the longitudinal fracture in the east portion was flat, oriented on a radial plane of the pipe, exhibited little plastic deformation, and displayed fine fractographic details. Shear lips were generally present along the inside and/or outside surfaces of the pipe. Figure 24 shows a close-up view of the longitudinal fracture surface approximately 42 feet east of the transverse fracture. This location is close to the circumferential field girth weld located approximately 43 feet east of the transverse fracture (Figure 7). Fine chevron marks indicate that, at this location, the fracture propagated to the east, away from the transverse-fractured end of the east portion. Shear lips are quite evident along both the inside and outside surfaces.

Figure 25 shows a close-up view of the longitudinal fracture surface approximately 30 feet to the east of the transverse fracture in the east portion of the sales gas line. At this location, the fracture features were similar to those observed 42 feet east of the transverse fracture; however, there were no clear chevron marks indicating the direction of fracture propagation.

Figure 26 shows a similar view 20 feet east of the transverse fracture. The fracture features are similar to those of the 30-foot location, and there are not clear chevron marks indicating the direction of fracture propagation. The same is true approximately 10 feet east of the transverse fracture, as shown in Figure 27.

At a distance of approximately 1.5 feet east of the transverse fracture, chevron marks are distinct on the longitudinal fracture. The chevron marks indicate that the fracture propagated to the east at this location, as shown in Figure 28. Similar features were observed at a distance of approximately 1.3 feet east of the transverse fracture, as shown in Figure 29. Figure 29 also shows the west end of a bend in the longitudinal fracture surface resulting from the large dent shown in Figures 15 and 30.

Figure 31 shows the longitudinal fracture at approximately 1 foot east of the transverse fracture, near the center of the bend. Clear chevron marks are not evident at this location, but a step change in the plane of the fracture indicates the most likely location of the fracture origin. The west side of the likely origin area is shown in Figure 32, which is centered at approximately 0.8 feet east of the transverse fracture.

Further to the west at 0.6 feet from the transverse fracture, Figure 33 shows the resumption of chevron marks. These chevron marks indicate that the fracture propagated to the west, towards the transverse fracture. The reversal in the direction of fracture propagation is consistent with a fracture origin area located in the bend caused by the large dent shown in Figures 15 and 30.

Figure 34 shows the longitudinal fracture at a distance of about 0.35 feet from the transverse fracture. More chevron marks are evident, and they indicate that the fracture continued propagating towards the west at this location.

Figure 35 shows the west end of the longitudinal fracture in the east portion of the sales gas line. Chevron marks show that the fracture propagation direction continued toward the west at this location. A large shear lip developed where the longitudinal fracture met the transverse fracture.

Figure 36 shows the transverse fracture on the west end of the east portion of the sales gas line. The fracture features, shown close-up in Figure 37, are consistent with ductile tearing. The direction of fracture propagation is not evident. The edge of the transverse fracture surface along

the outside surface of the pipe was deformed and abraded on the left end of the transverse fracture shown in Figure 36. The damage, shown in Figure 38, was apparently caused by impact with a foreign object following the fracture.

Figure 39 shows the east end of the longitudinal fracture in the east portion of the sales gas line. The fracture has ductile shear morphology after the fracture crossed the field girth weld.

3.3 Dimensional Measurements

The outside and inside diameters of the ruptured sales gas line were measured using transfer calipers. The outside diameter was measured six inches to the east of the field girth weld shown in Figure 6. This location was chosen because the pipe had not fractured longitudinally in this location, nor was there significant external coating to interfere with the measurement. The pipe was not cleaned to bare metal for the measurements. The outside diameter measured 8.651 inches compared to a nominal outside diameter of 8.625 inches for new pipe. The inside diameter of the ruptured pipe was measured in nearly the same area, twelve inches west of the transverse fracture shown in Figure 6. Again this location was chosen to be the most representative of the pipe prior to the rupture. The inside diameter measured 8.110 inches versus a nominal of 8.125 inches for new pipe.

Wall thickness measurements were made along the longitudinal and transverse fractures at the west end of the east portion of the sales gas line and in a remote location near the east end of the longitudinal fracture. The measurements were made using a snap gage micrometer. Along the fractures, measurements were made approximately 1/4-inch from the fracture surface and 1-1/4 inches from the fracture surfaces (Figures 40 and 41). Figure 42 shows the location of the remote wall thickness measurement. The surfaces of the pipe were not cleaned to bare metal for the measurements. The wall thickness measurements are presented in Table 1 along with the nominal wall thickness for new pipe.

Table 1: Wall Thickness Measurements of East Portion of Sales Gas Line

Location (see Figures 40-42)	Nearby Fracture	Wall Thickness (Inches) 1/4-Inch from Fracture	Wall Thickness (Inches) 1-1/4 Inch from Fracture
1	Longitudinal	0.258	Coating Interference
2	Longitudinal	0.255	Coating Interference
3	Longitudinal	0.263	0.250
4	Longitudinal	0.254	0.249
5	Longitudinal/Transverse	0.239	0.249
6	Transverse	0.227	0.244
7	Transverse	0.223	0.245
8	Transverse	0.239	0.242
9	Transverse	0.239	0.239
10	Longitudinal/Transverse	0.201	0.210
11	Longitudinal	0.252	0.245
12 (close to origin)	Longitudinal	0.258	0.249
13	Longitudinal	0.256	0.250
14	Longitudinal	0.255	0.252
		Other Location	
Remote	None	0.252	NA
Nominal-New Pipe	None	0.250	NA

NA – Not applicable

3.4 Hardness Measurements

Ten hardness measurements were made in a remote location approximately four feet east of the transverse fracture in the east portion of the sales gas line (Figure 43). This location was not in the vicinity of a weld. The outside surface of the pipe was mechanically polished to a final finish of 600-grit abrasive paper prior to testing. The measurements were made using a Microdur II hardness tester. The hardness measurements ranged from Rockwell B 83.0 to 86.3 with an average of 84.9.

3.5 External Coatings

The exterior of the sales gas line pipes had been coated with a plant applied, spiral wrapped, asphalt-type coating shown in Figure 44, except for the ends that were welded in the field. The pipes were then coated with wire-reinforced concrete on top of the spiral wrapped asphalt (Figures 5, 6, 13, 16, 18, and 20). The thickness of the concrete ranged from 1.2 to 1.5 inches in

several locations. After field girth welding, the welded joints were coated with an asphalt-type material but not concrete.

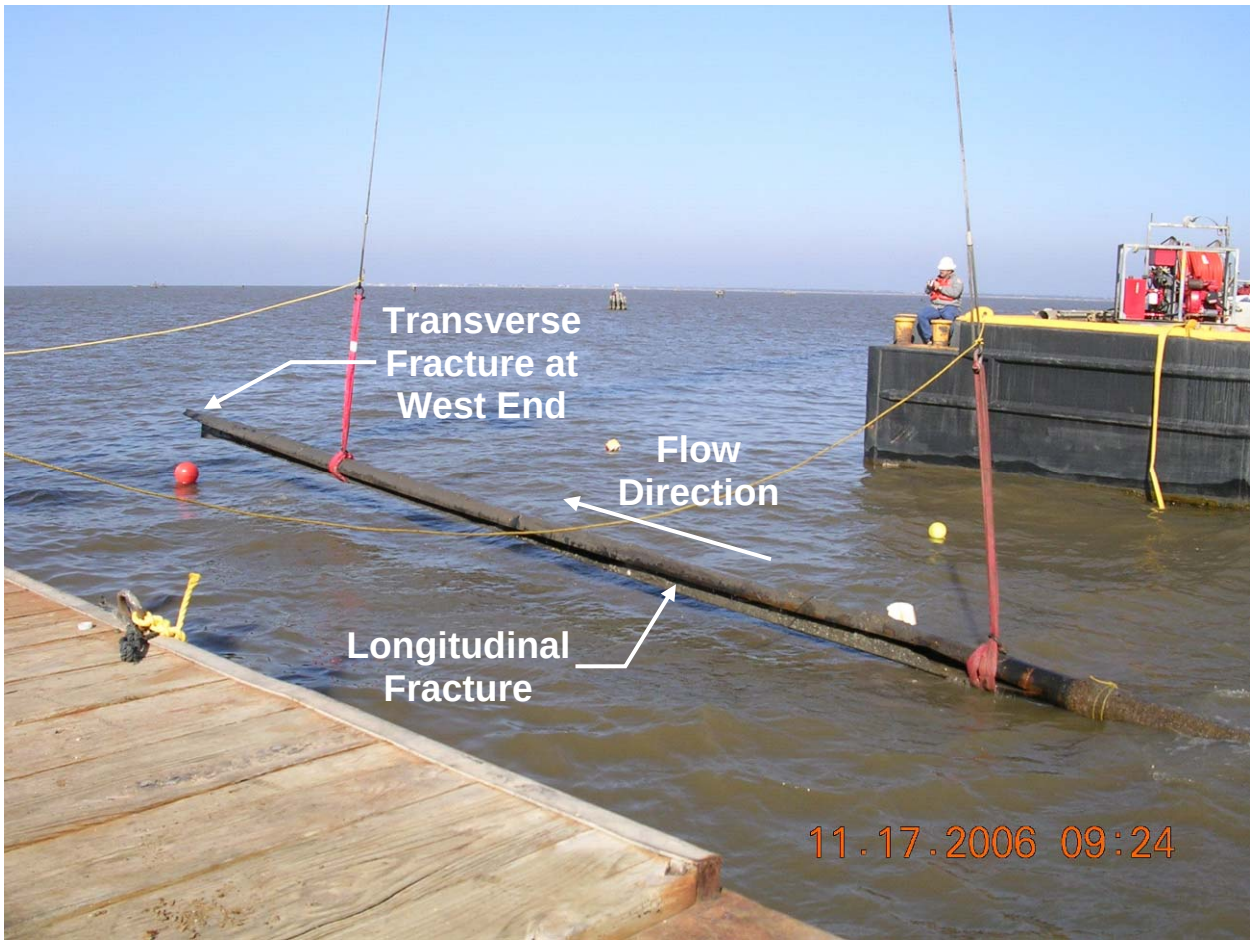

Figure 1: The east portion of the sales gas line as it was being salvaged. Notice the transverse and longitudinal fractures.

Figure 2: The east portion of the sales gas line during salvaging as viewed from the transverse-fractured, west end.

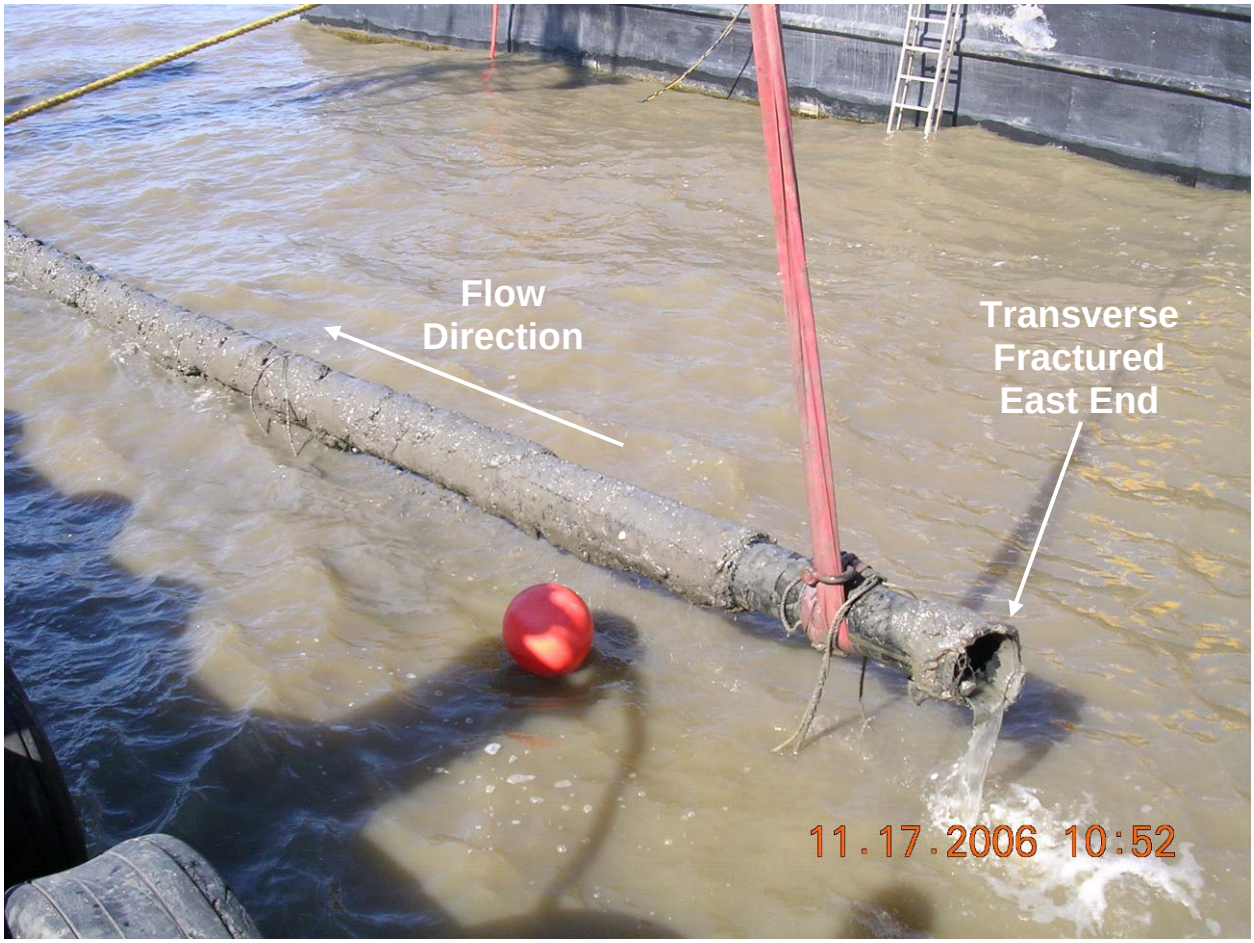

Figure 3: The fractured east end of the west portion of the sales gas line during salvaging. Notice the location of the transverse fracture.

Figure 4: The east and west portions of the sales gas line during salvaging.

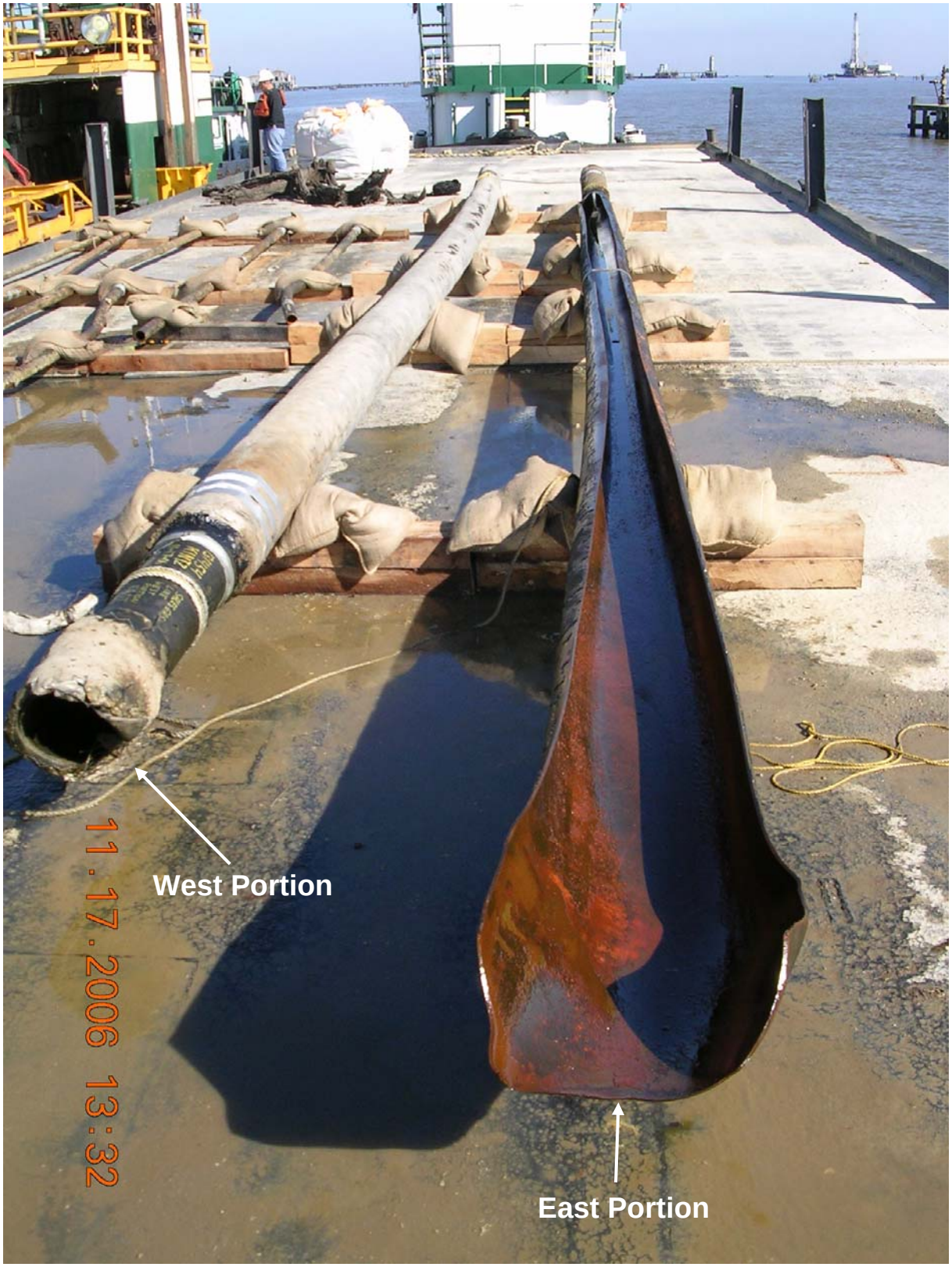

Figure 5: The east and west portions of the sales gas line shortly after salvaging as viewed from their mating, transverse-fractured ends.

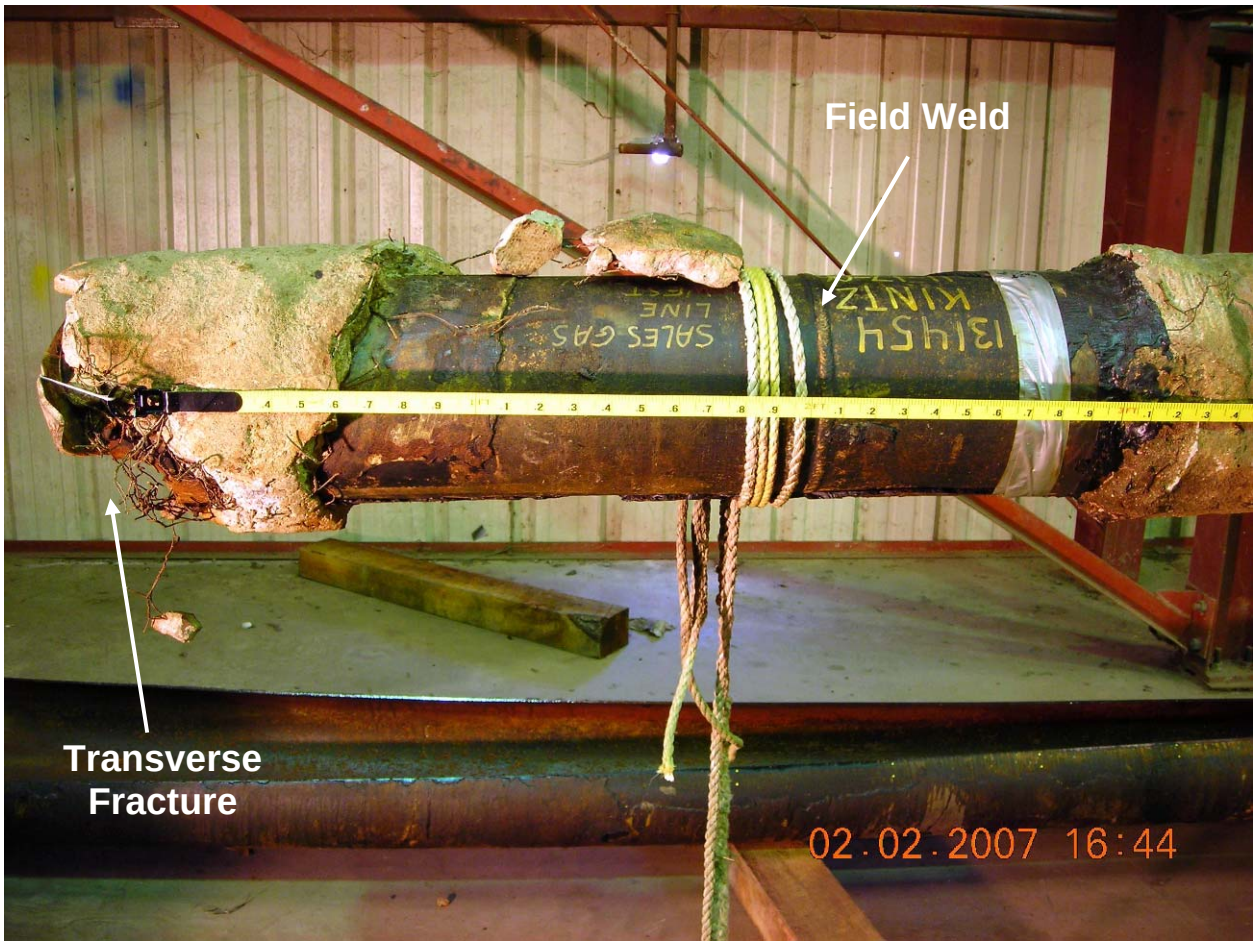

Figure 6: The east end of the west portion of the sales gas line showing the location of the transverse fracture, approximately 2.1 feet east of a circumferential field girth weld.

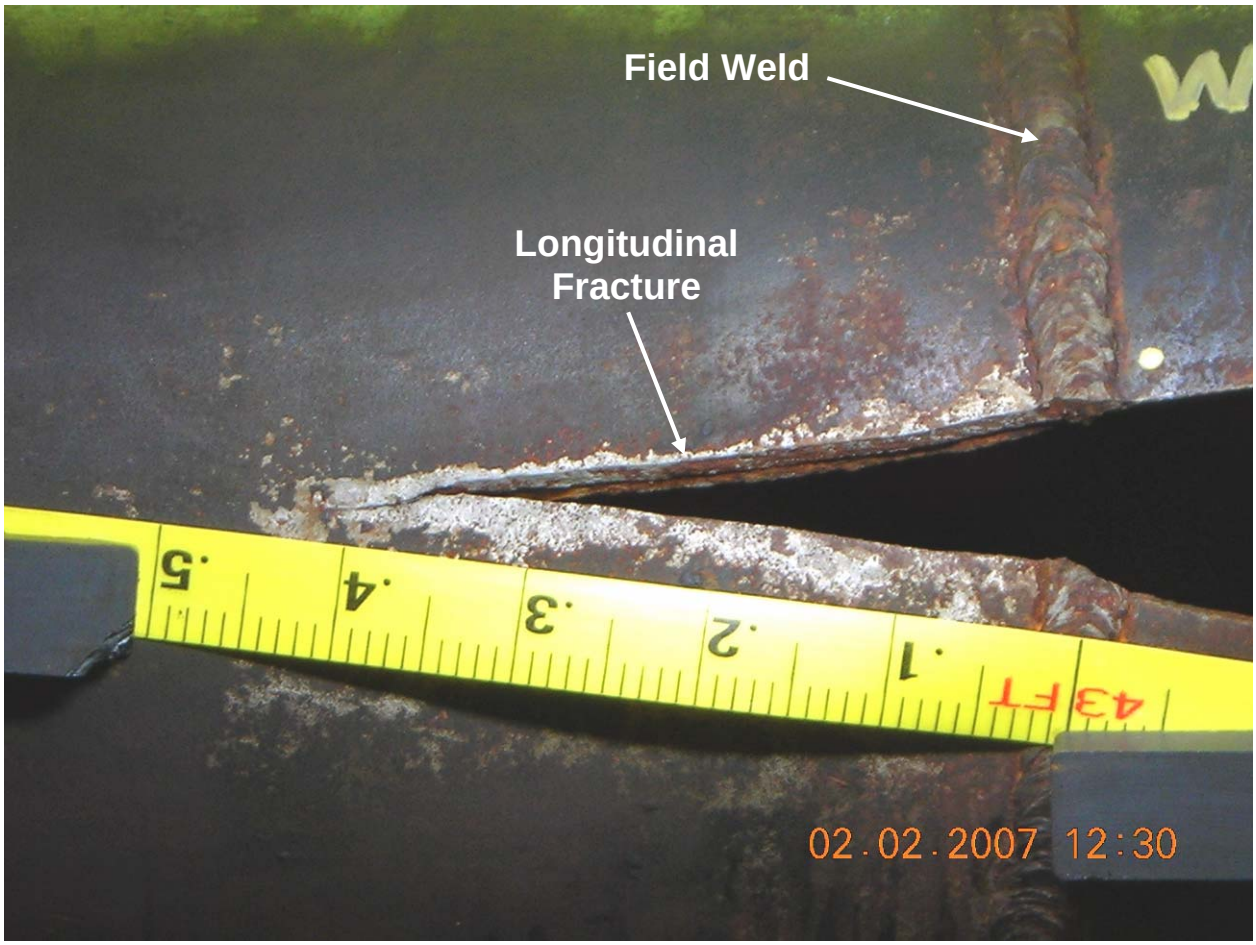

Figure 7: The east end of the longitudinal fracture in the east portion of the sales gas line, approximately 43.4 feet east of the transverse fracture. Notice the location of the field girth weld.

Figure 8: The knotted rope indicating the geometric top of the east portion of the sales gas line as the pipe was found after the rupture.

Figure 9: The knotted rope indicating the geometric top of the west portion of the sales gas line as the pipe was found following the rupture.

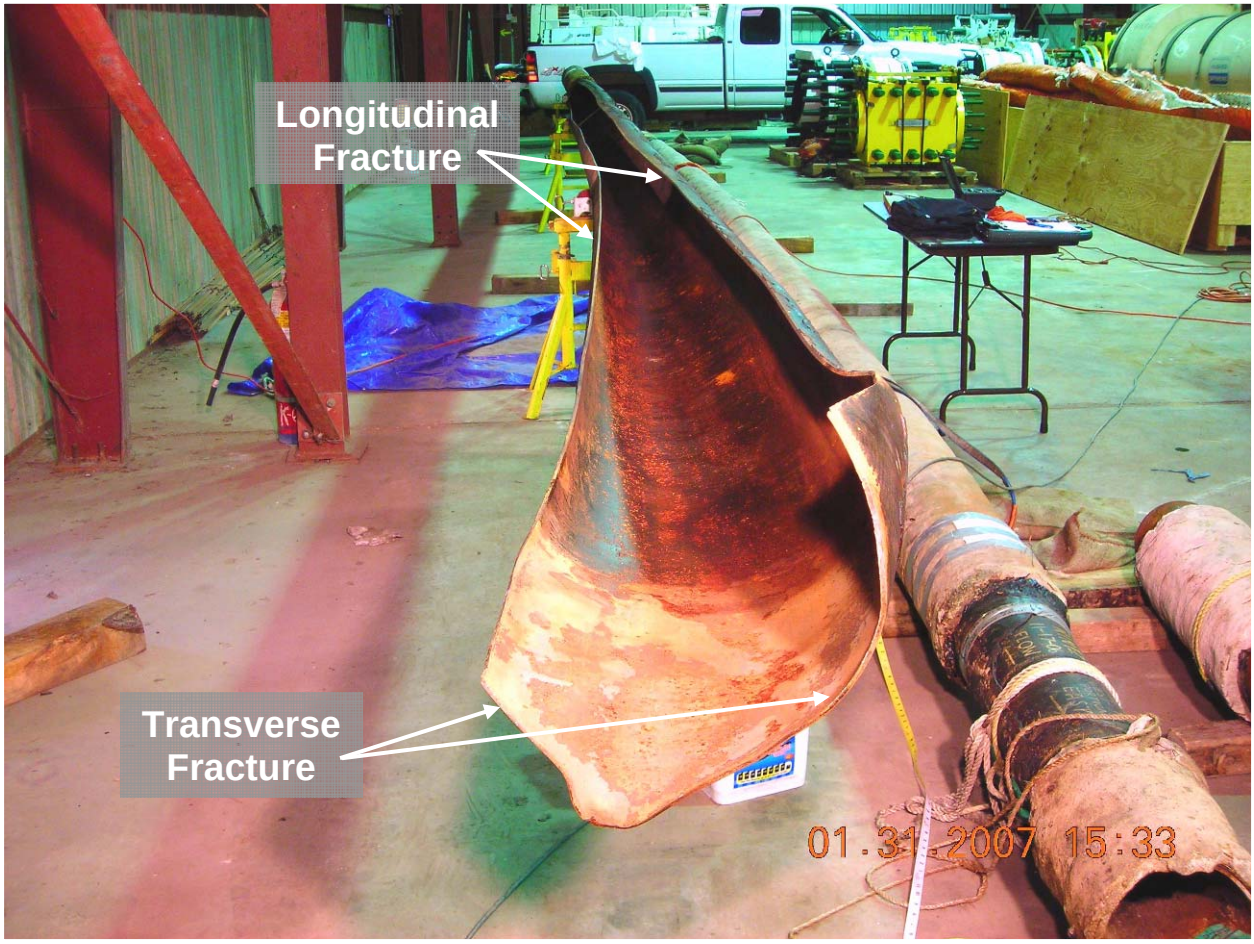

Figure 10: The east portion of the sales gas line rotated such that the knot indicating the geometric top of the pipe as it was discovered following the rupture was located at the bottom. Notice that the longitudinal fracture was located near the geometric bottom of the pipe as it was discovered following the rupture.

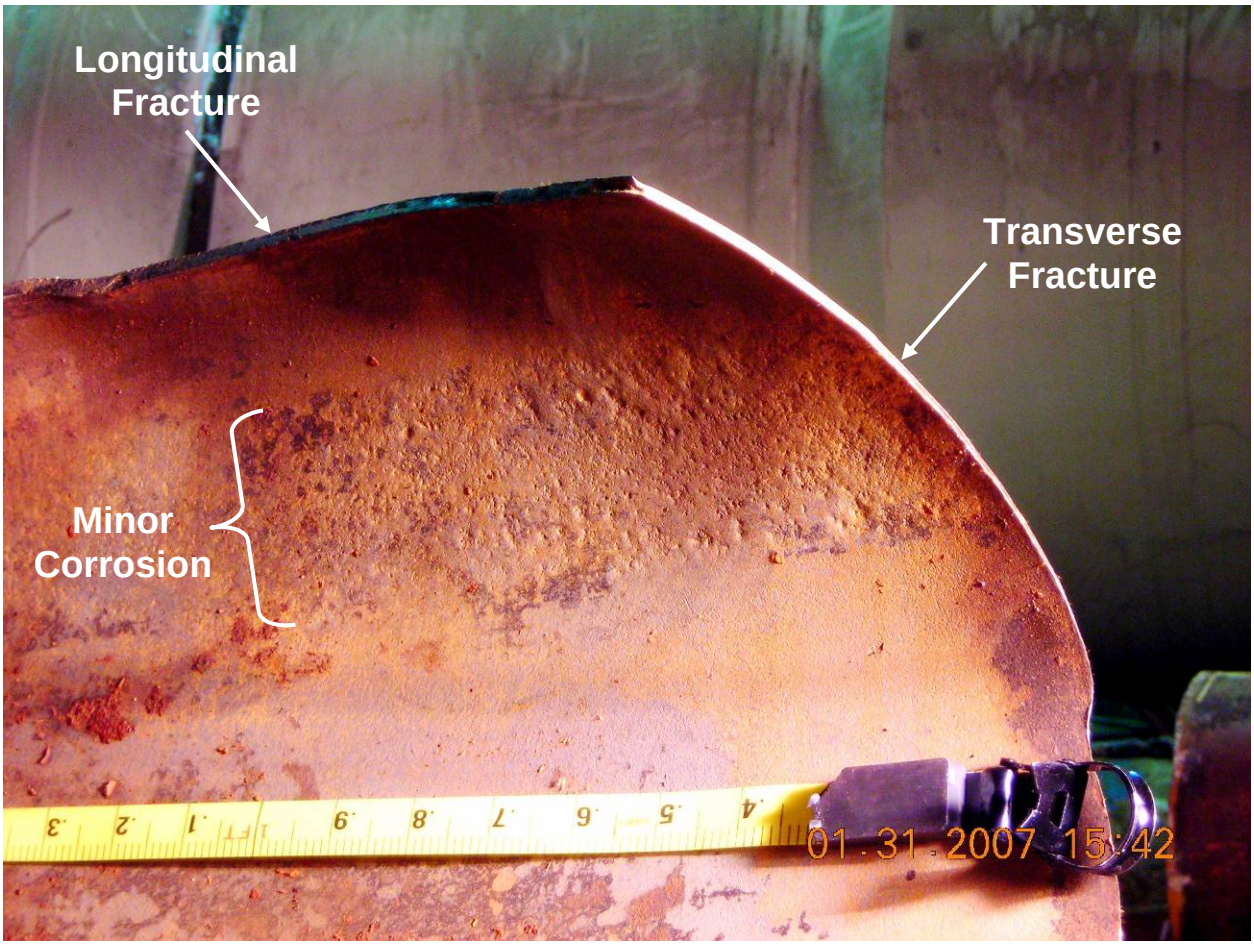

Figure 11: **A longitudinal band of minor corrosion pitting on the inside surface of the east portion adjacent to the transverse fracture. Notice that the longitudinal fracture is located outside of the band of pitting.**

Figure 12: Part of the longitudinal fracture in the east portion of the sales gas line. Notice that the fracture followed the longitudinal pipe weld.

Figure 13: The east end of the west portion of the sales gas line showing the location of the longitudinal pipe weld with respect to the rope knot indicating the geometric top of the pipe as it was found after the rupture. Notice that the longitudinal weld is not fractured.

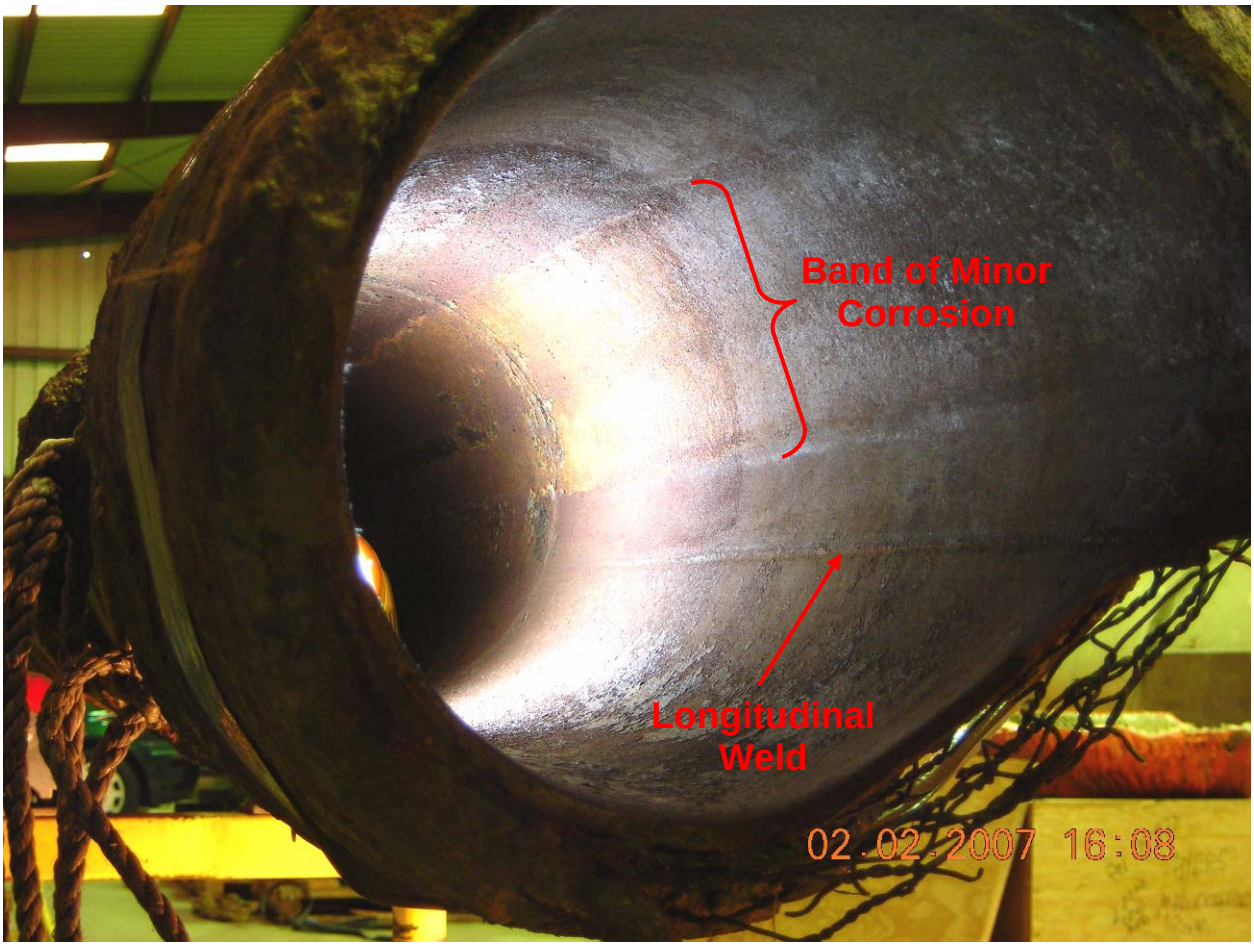

Figure 14: The east end of the west portion of the sales gas line showing the location of a longitudinal band of minor corrosion indicating the most likely position of the geometric bottom of the pipe prior to the rupture and the location of the longitudinal pipe weld.

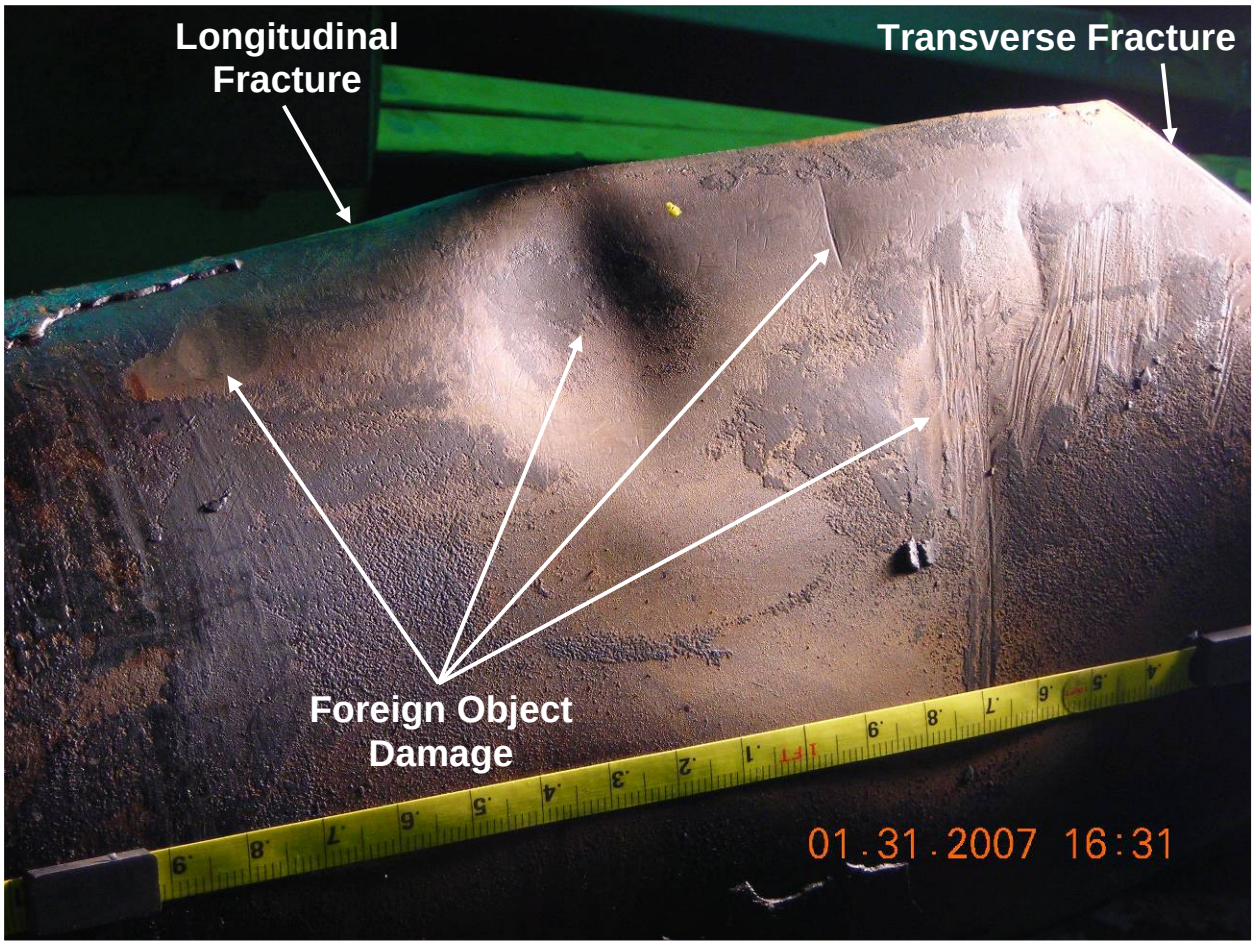

Figure 15: Foreign object damage located on the outside surface of the west end of the east portion of the sales gas line adjacent to the transverse and longitudinal fractures.

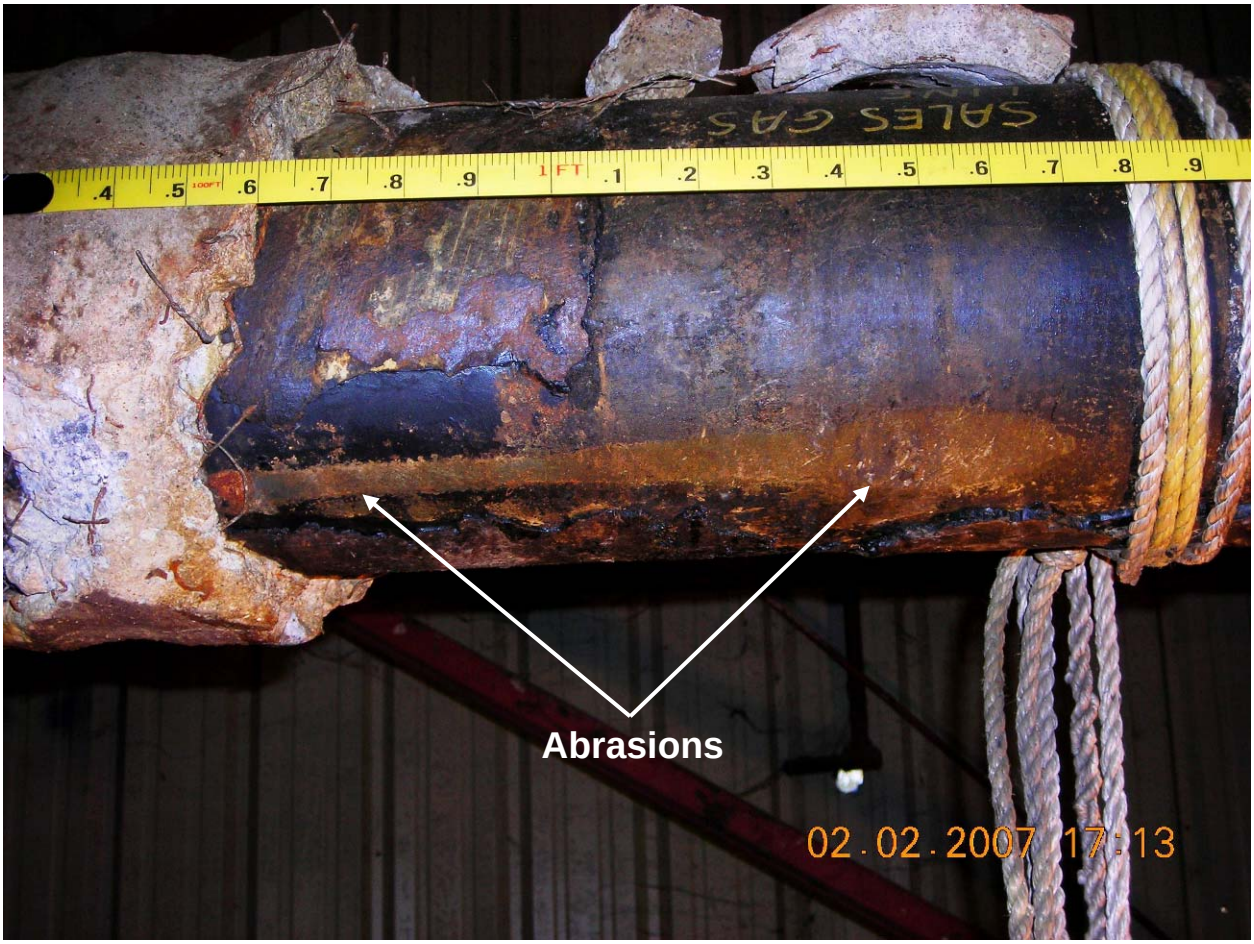

Figure 16: Abrasions in the field weld joint closest to the transverse fracture in the west portion of the sales gas line.

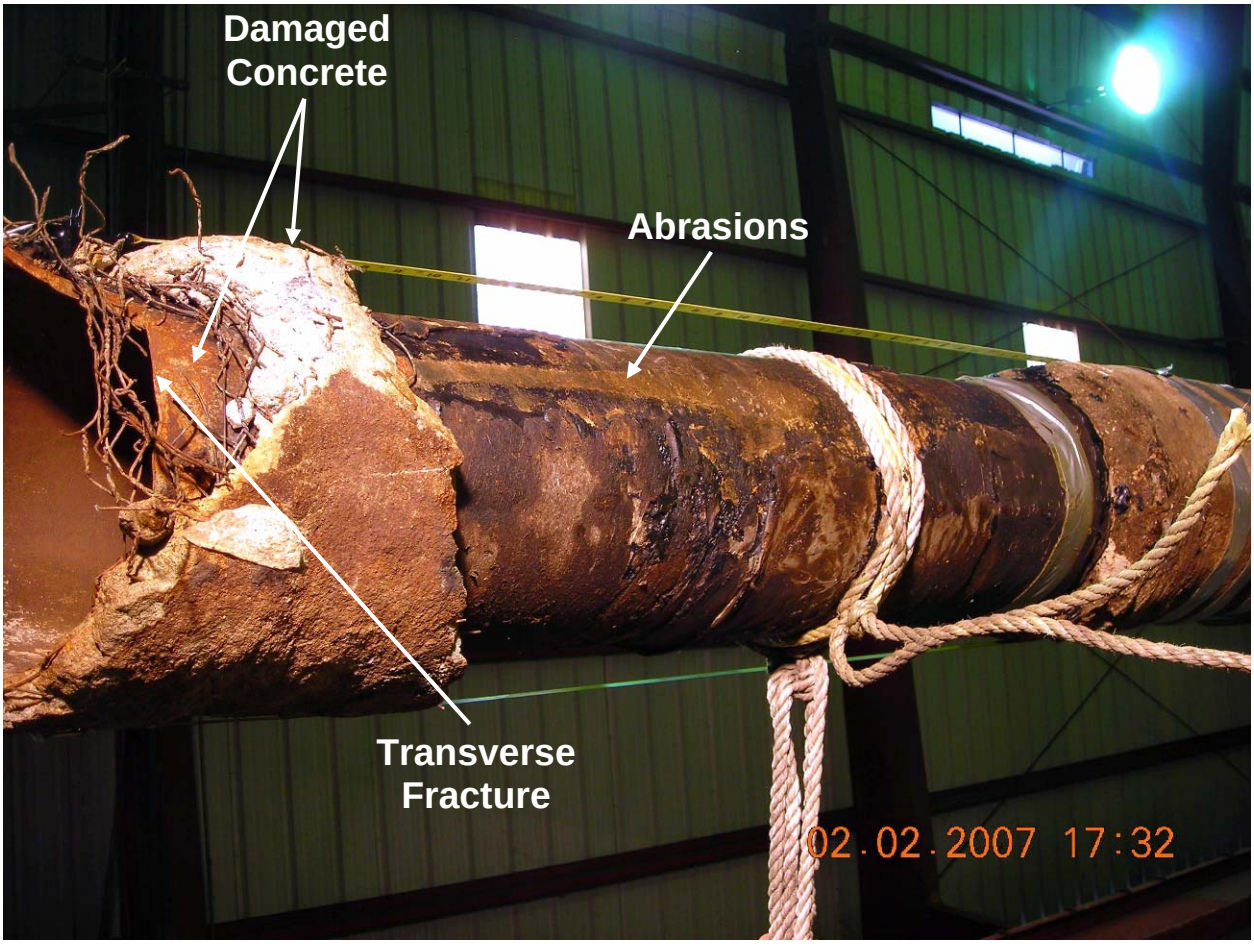

Figure 17: The east end of the west portion of the sales gas line showing damaged, wire-reinforced concrete adjacent to the transverse fracture.

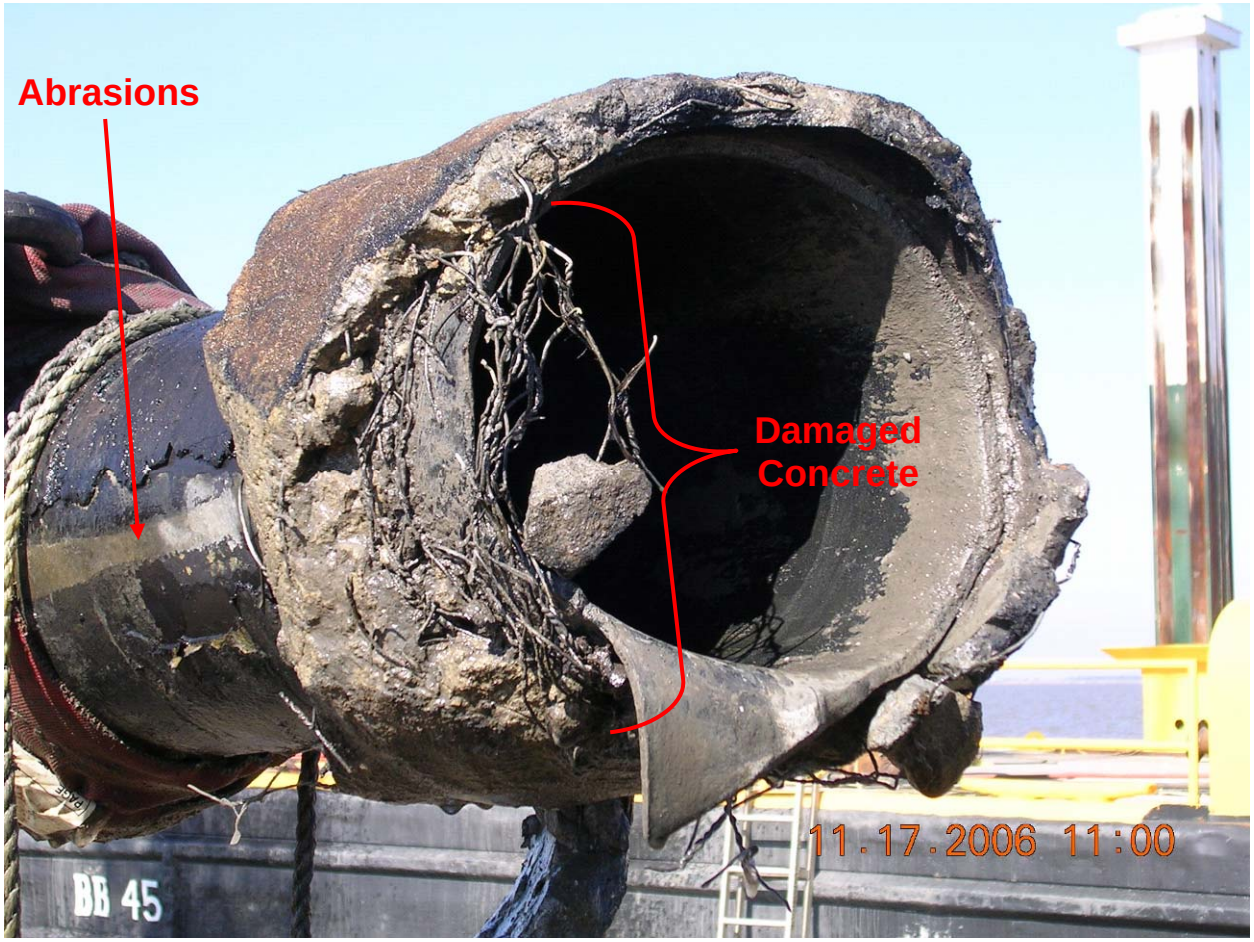

Figure 18: Abrasions in the field weld joint and substantial damage to the wire-reinforced concrete at the transverse fractured end of the west portion of the sales gas line. The photograph was taken during salvaging of the pipe.

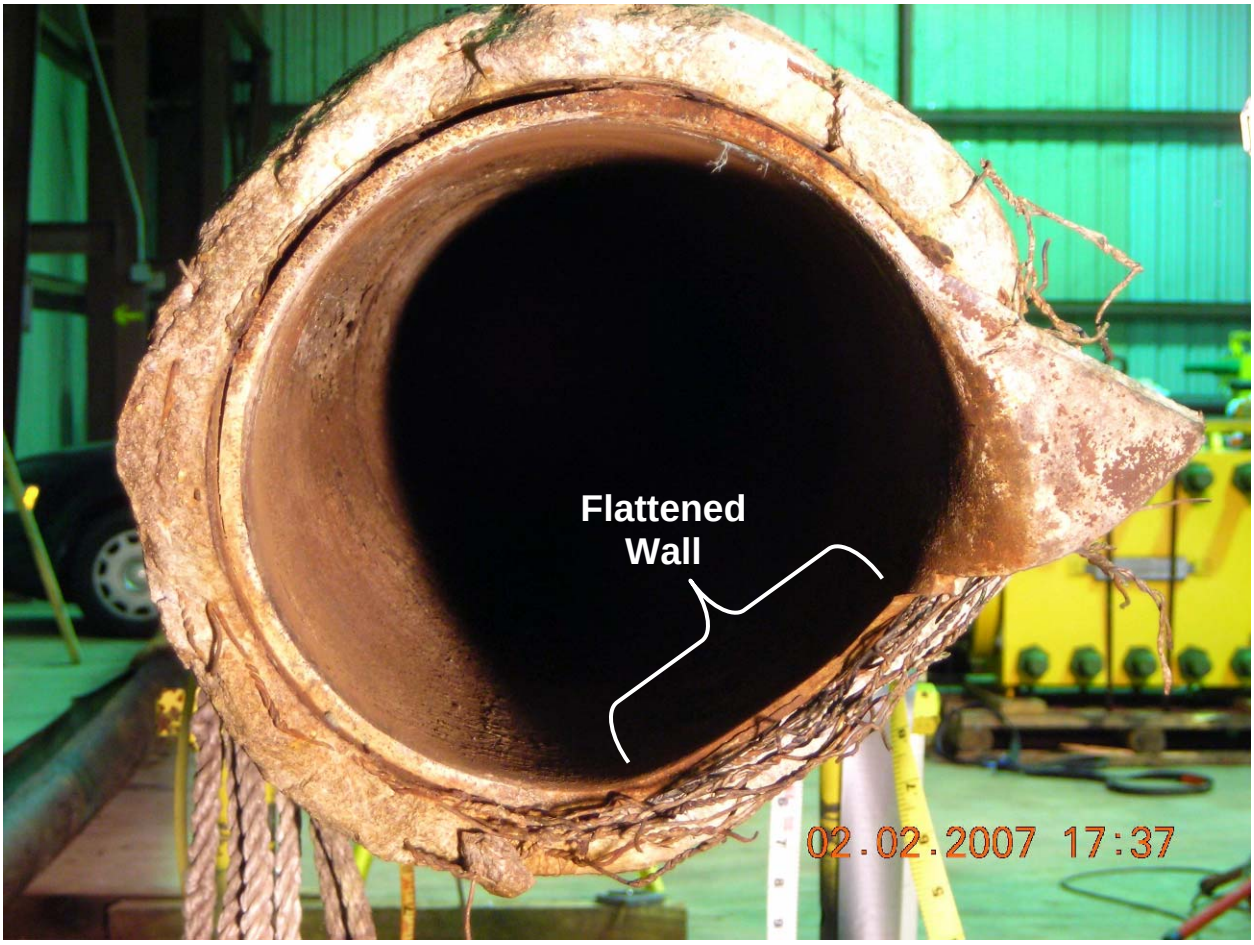

Figure 19: The transverse-fractured end of the west portion of the sales gas line showing inward deformation (flattening) of the pipe wall in the same location as the damaged concrete.

Figure 20: Abrasions along the outside surface of the concrete coating on the west portion of the sales gas line.

Figure 21: Cracked and spalled concrete coating located approximately 16.2 feet from the transverse fracture in the west portion of the sales gas line.

Figure 22: Cracked and spalled concrete coating located approximately 20.5 feet from the transverse fracture in the west portion of the sales gas line.

Figure 23: Cracked and spalled concrete coating located approximately 33.4 feet from the transverse fracture in the west portion of the sales gas line.

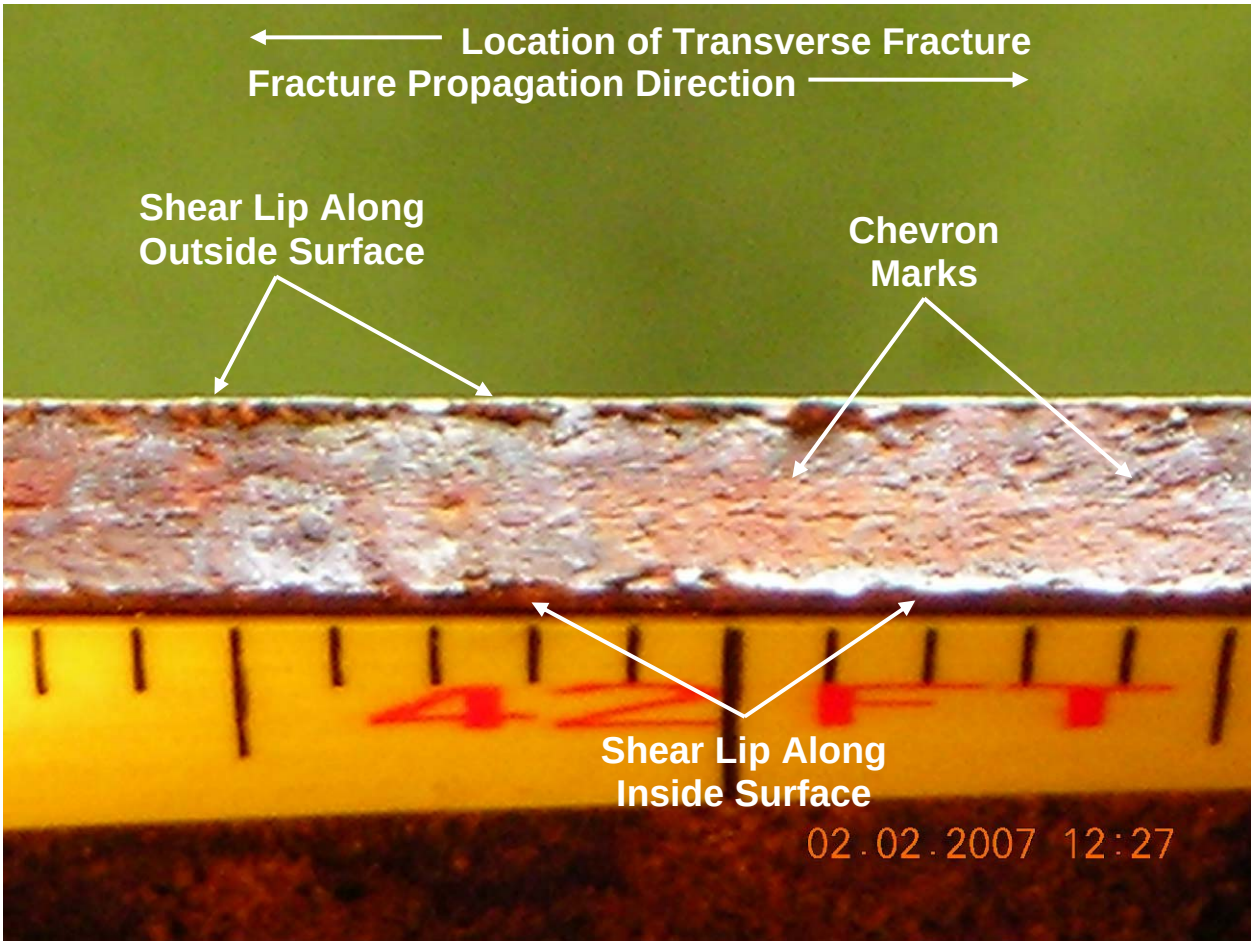

Figure 24: **Close-up view of the longitudinal fracture surface approximately 42 feet east of the transverse fracture in the east portion of the sales gas line. Notice that most of the fracture surface is flat with little plastic deformation, fine fractographic details, and shear lips along the inside and outside surfaces of the pipe. Fine chevron marks indicate that the crack propagated to the east, away from the transverse fracture, at this location.**

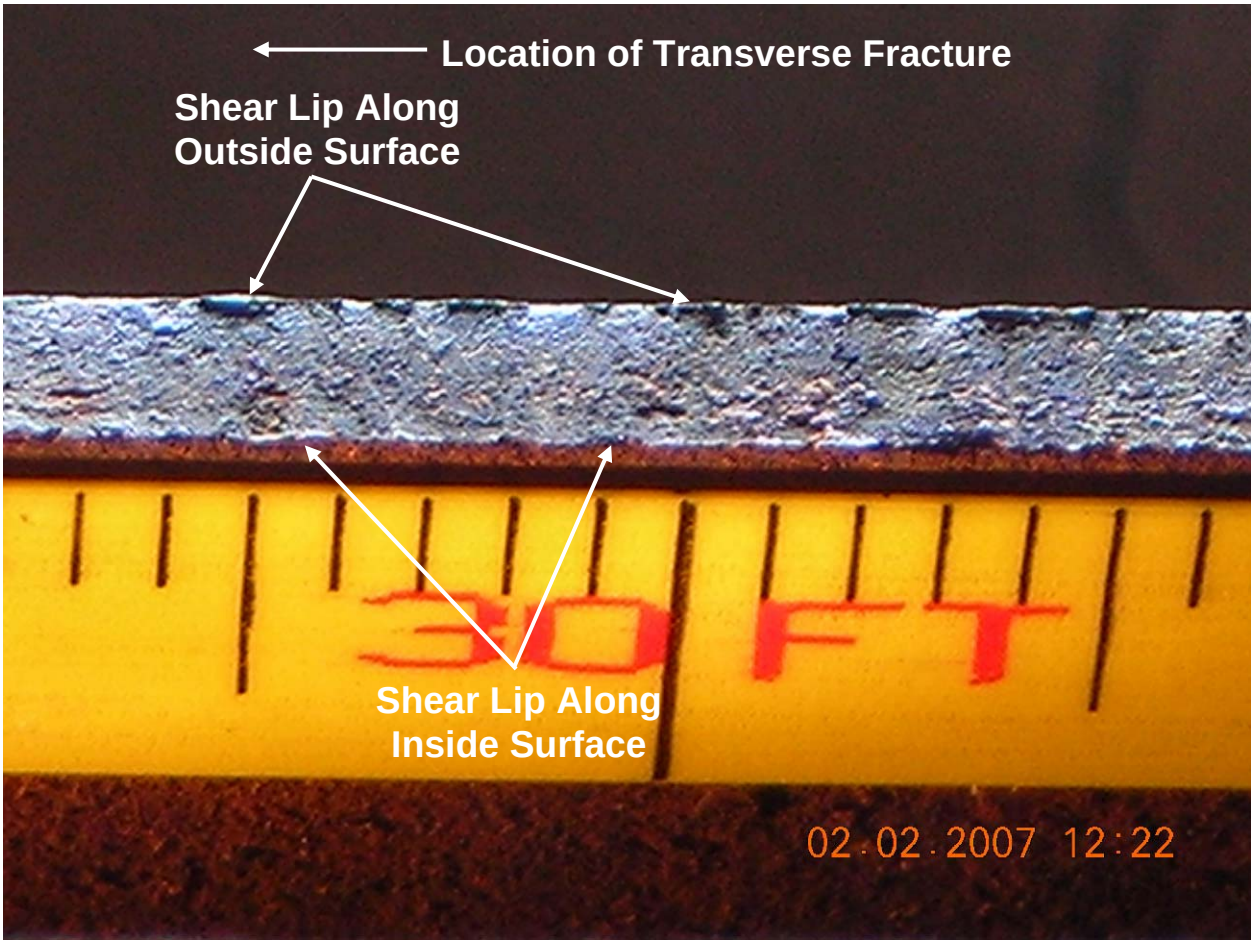

Figure 25: **Close-up view of the longitudinal fracture approximately 30 feet east of the transverse fracture in the east portion of the sales gas line. The fracture surface exhibits similar features as those shown in Figure 24; however, the fine fractographic details do not clearly indicate the fracture propagation direction.**

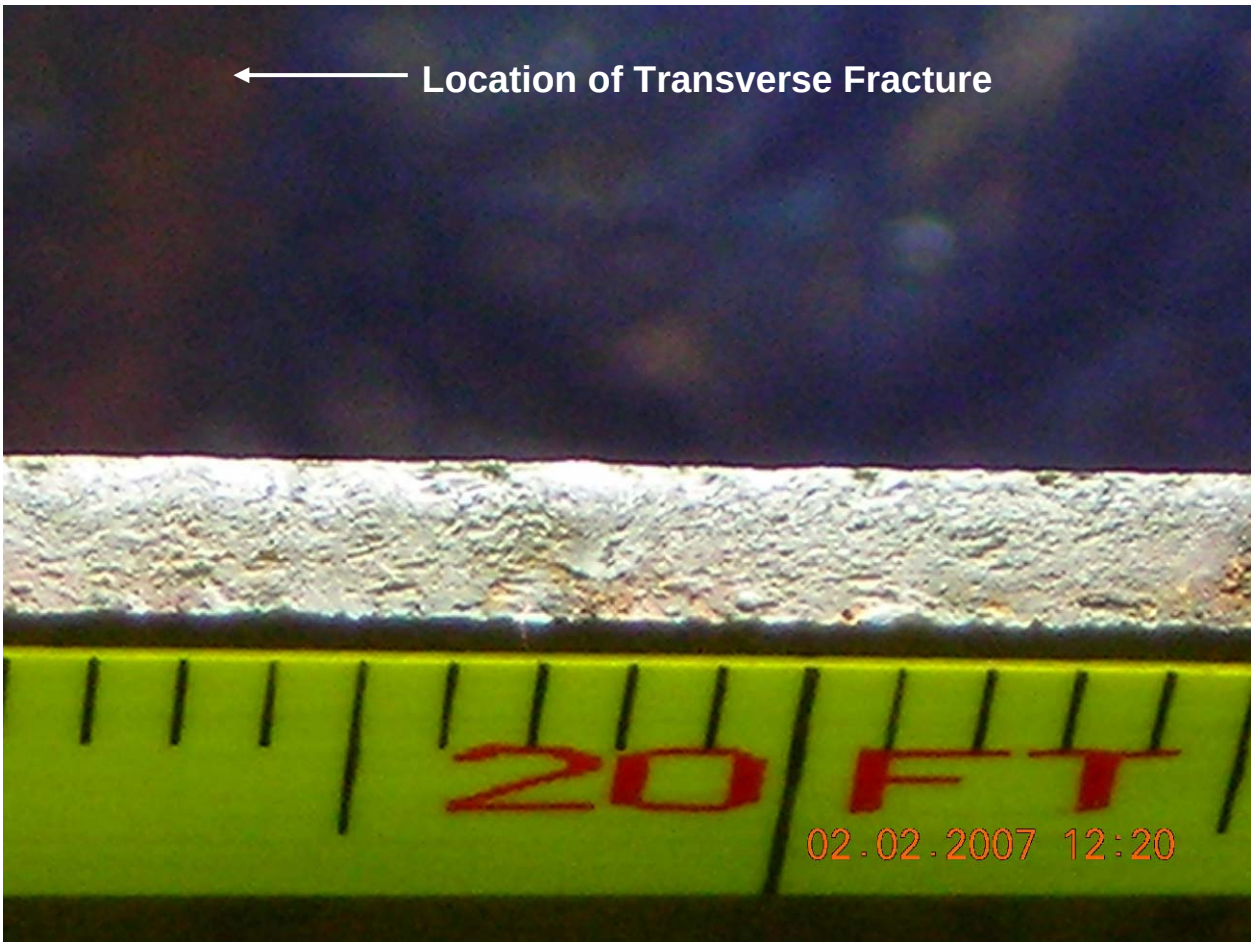

Figure 26: Close-up view of the longitudinal fracture approximately 20 feet east of the transverse fracture in the east portion of the sales gas line. The fracture features are similar to those of Figure 25; the fracture propagation direction is not clear.

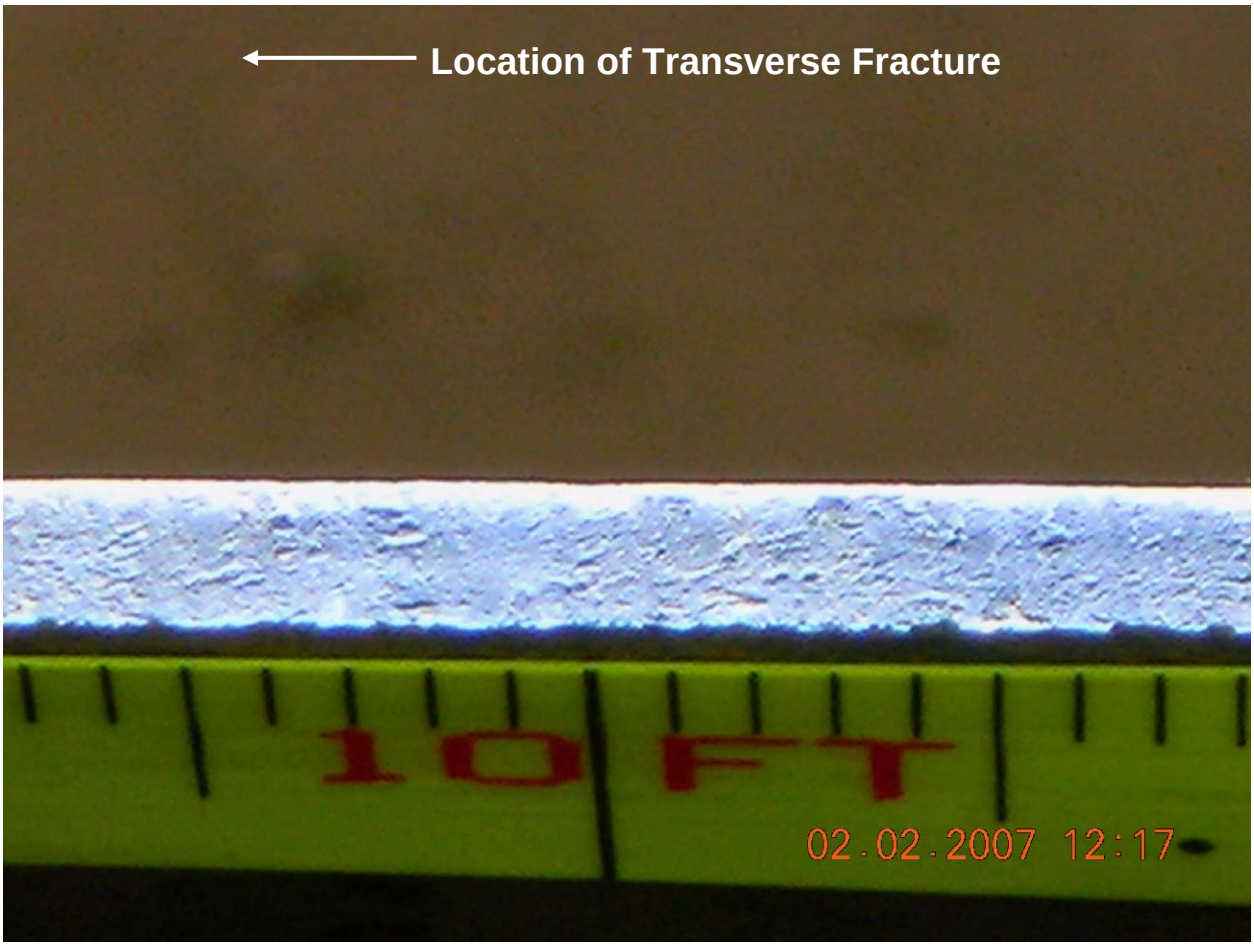

Figure 27: Close-up view of the longitudinal fracture approximately 10 feet east of the transverse fracture in the east portion of the sales gas line. The fracture features are similar to those of Figures 25 and 26; the fracture propagation direction is not clear.

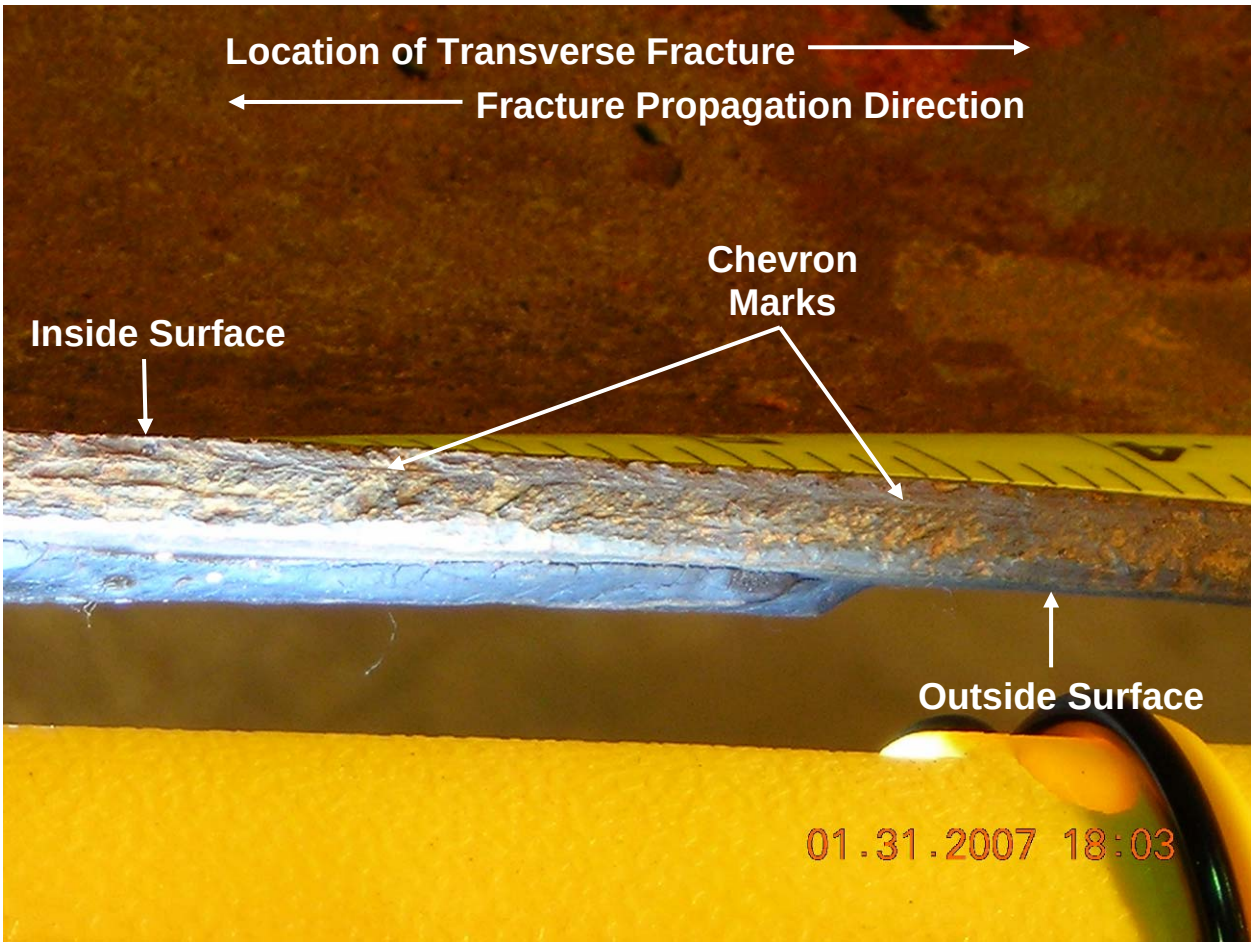

Figure 28: **Close-up view of the longitudinal fracture approximately 1.5 feet east of the transverse fracture in the east portion of the sales gas line. Notice the chevron marks indicating that the direction of fracture propagation was to the east, away from the transverse fracture.**

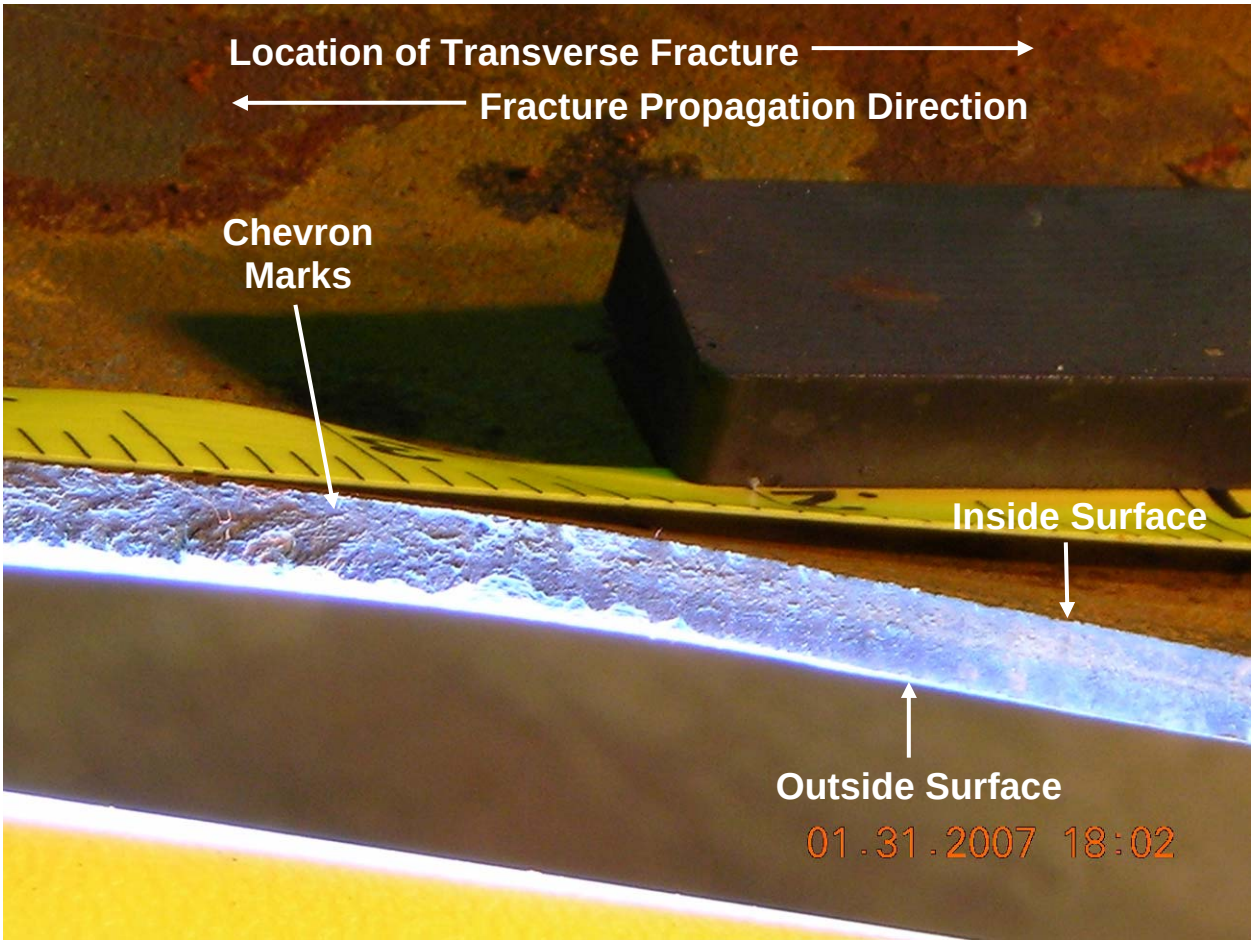

Figure 29: **Close-up view of the longitudinal fracture approximately 1.3 feet east of the transverse fracture in the east portion of the sales gas line. Notice the chevron marks indicating that the direction of fracture propagation was to the east, away from the transverse fracture. Also notice the bend in the fracture resulting from the dent shown in Figures 15 and 30.**

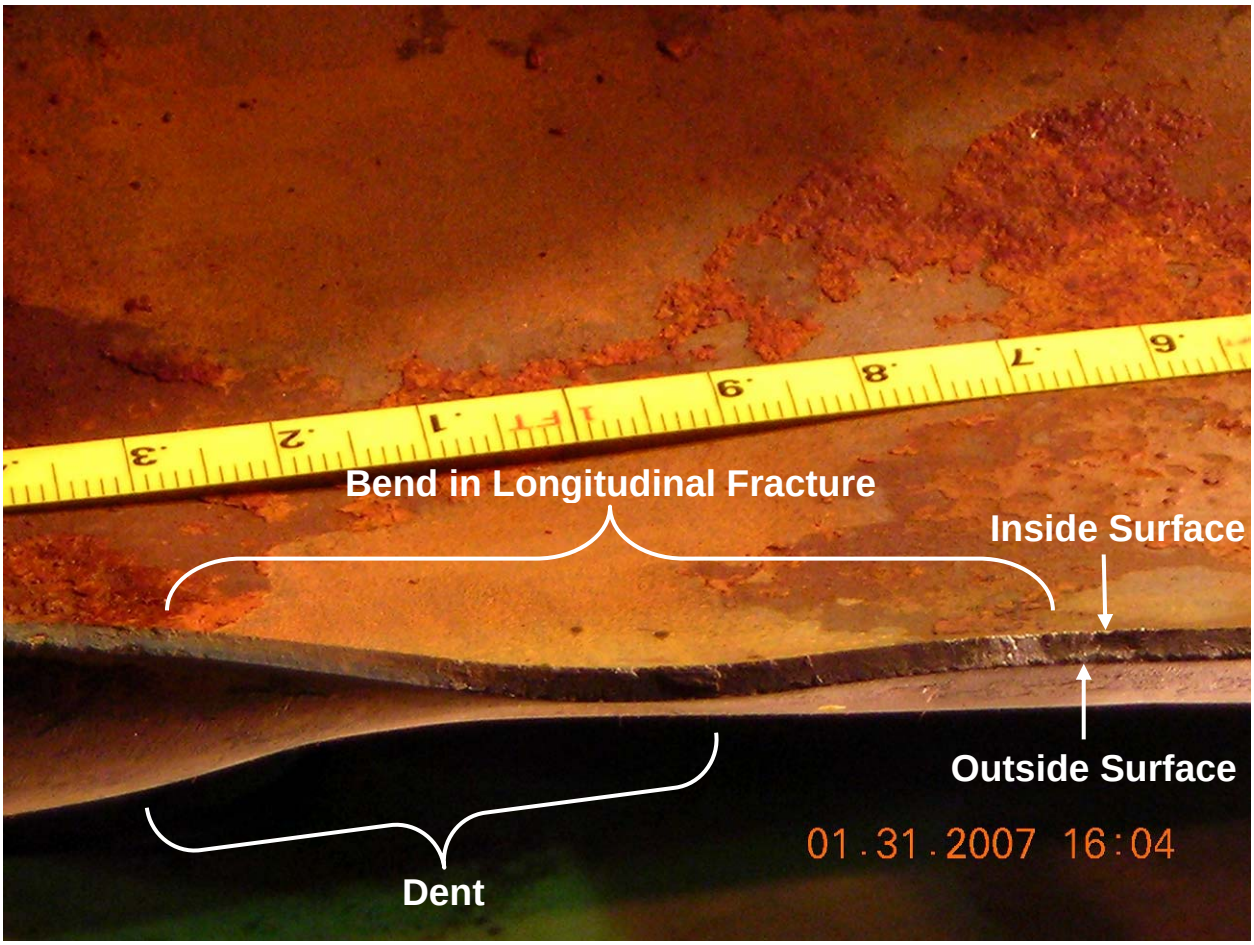

Figure 30: Bend in the longitudinal fracture located approximately 1 foot east of the transverse fracture in the east portion of the sales gas line. The bend was associated with the large dent shown in this photograph and Figure 15.

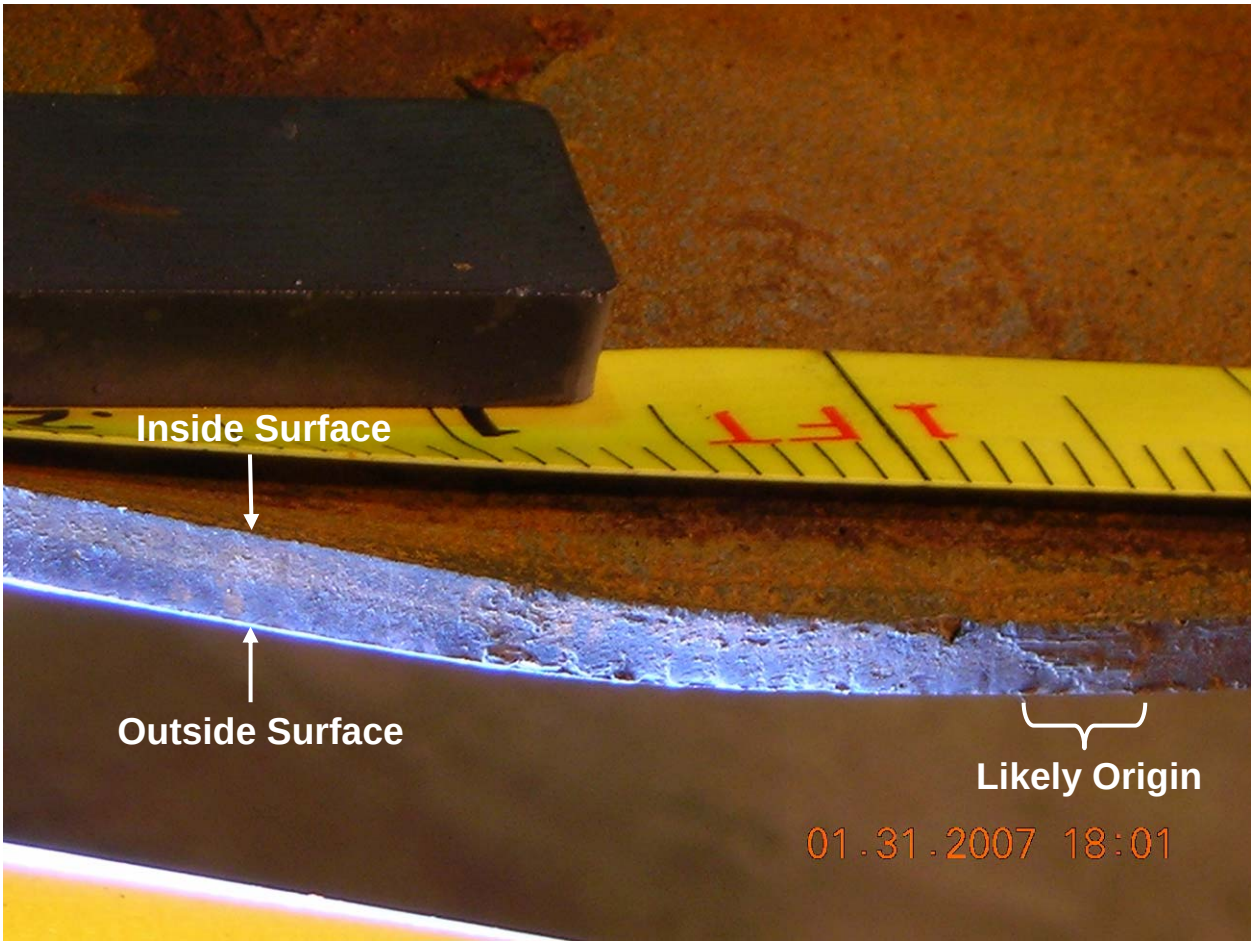

Figure 31: Close-up view of the longitudinal fracture approximately 1 foot east of the transverse fracture in the east portion of the sales gas line. This location corresponds with the approximate center of the bend in the fracture associated with the dent shown in Figures 15 and 30. No clear chevron marks are evident; however, a step change in the plane of the fracture indicates the likely fracture origin.

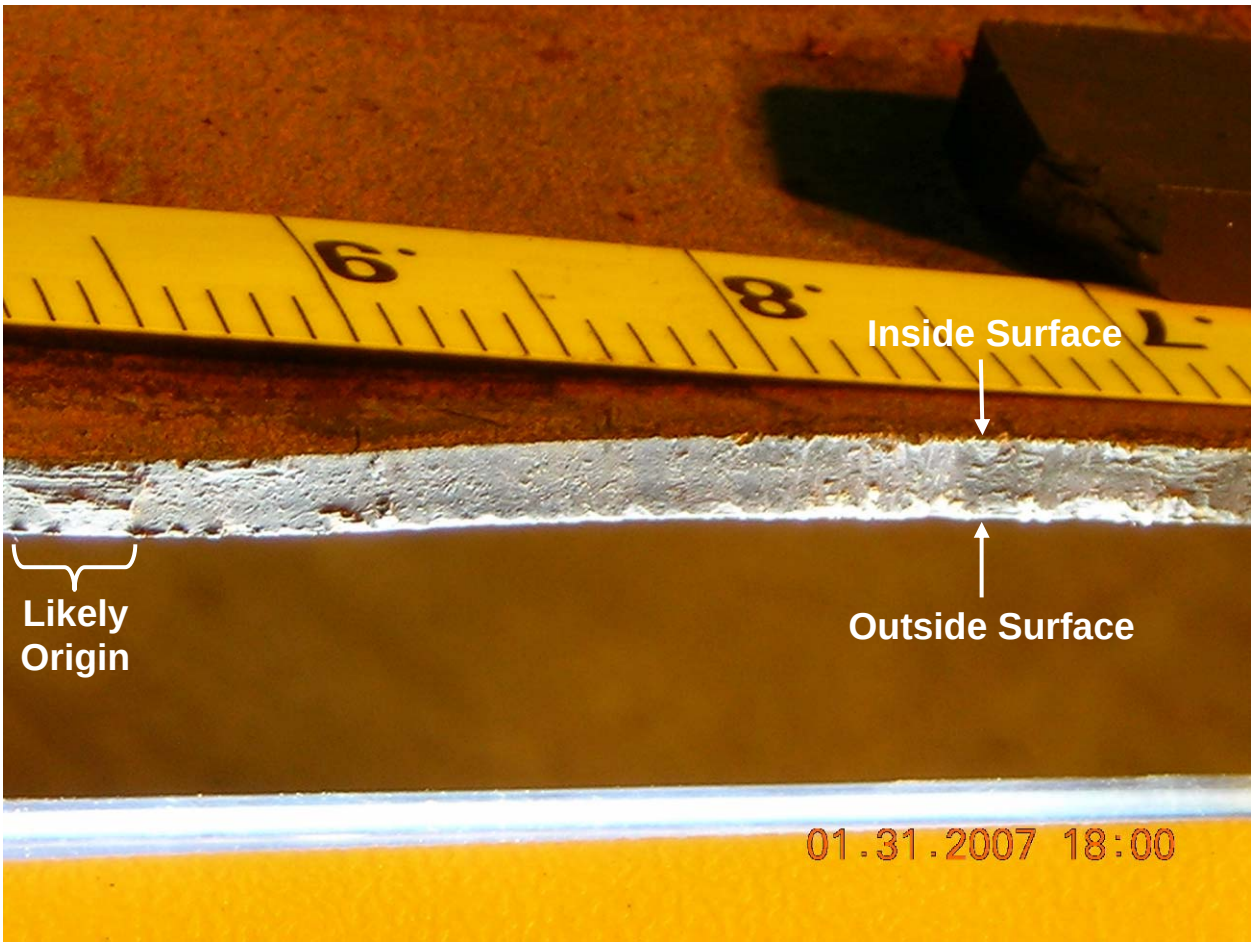

Figure 32: Close-up view of the longitudinal fracture approximately 0.8 feet east of the transverse fracture in the east portion of the sales gas line. No clear chevron marks are evident; however, a step change in the plane of the fracture indicates the likely fracture origin.

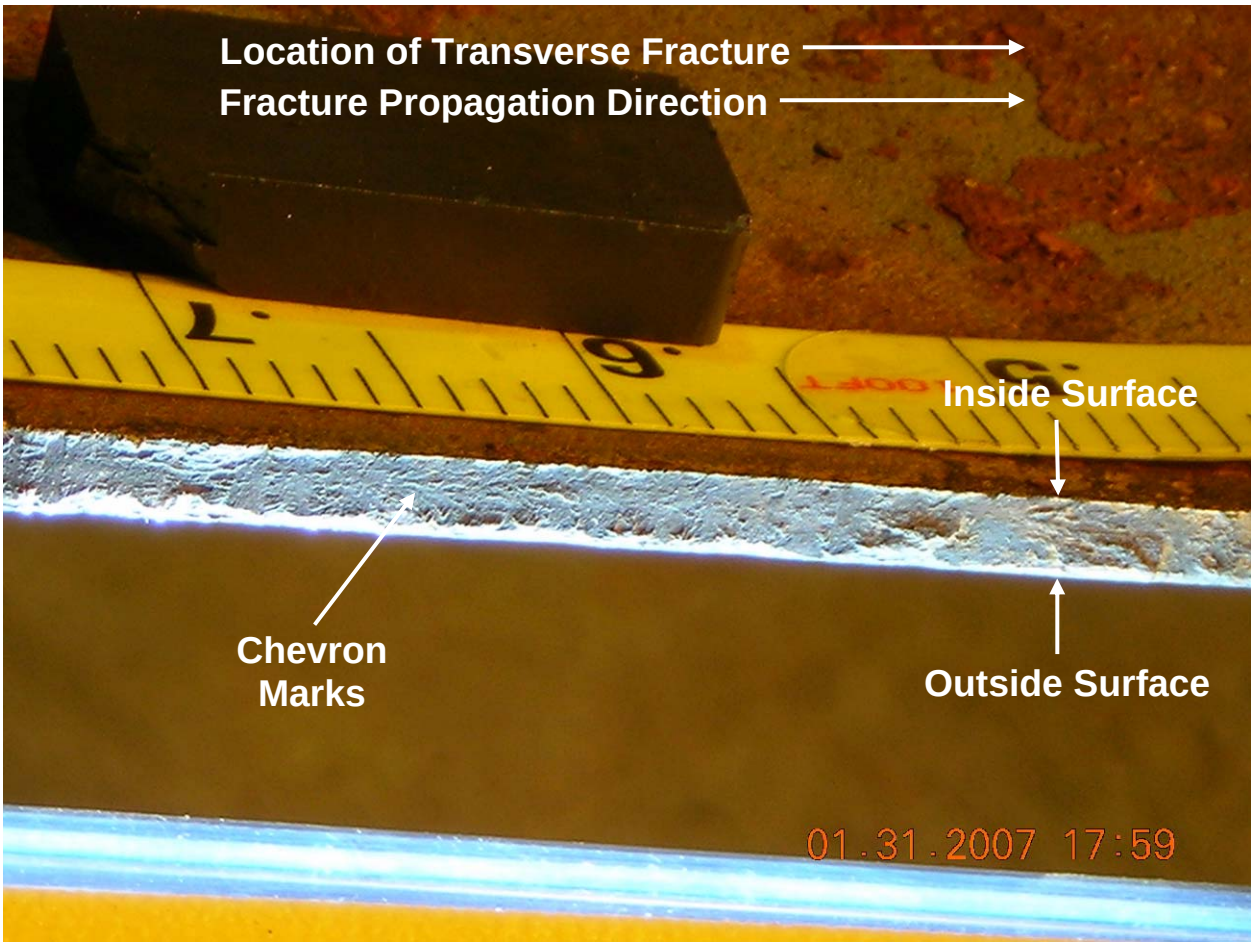

Figure 33: **Close-up view of the longitudinal fracture approximately 0.6 feet east of the transverse fracture in the east portion of the sales gas line. Chevron marks are again visible and indicate a change in the direction of fracture propagation to the west, towards the transverse fracture.**

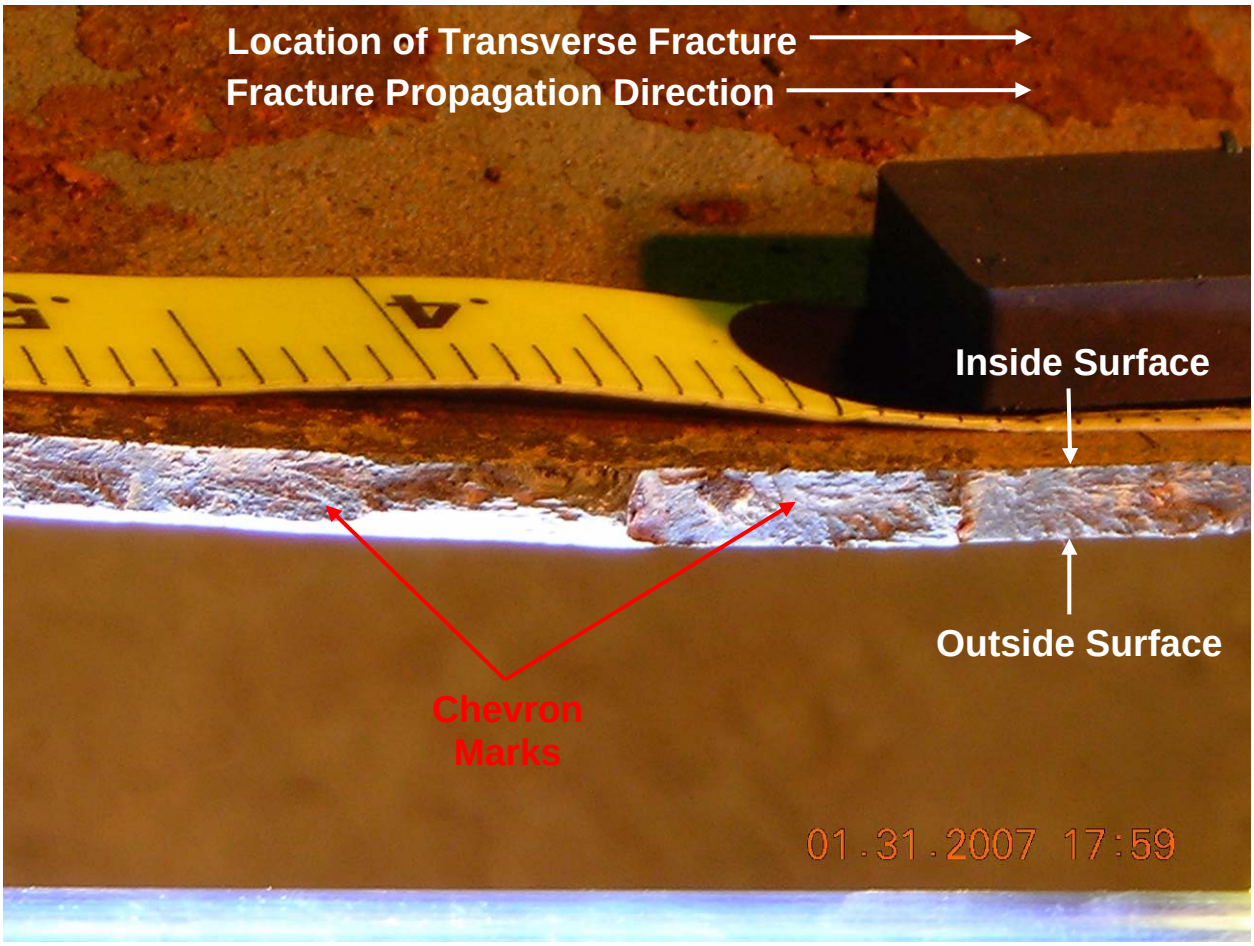

Figure 34: **Close-up view of the longitudinal fracture approximately 0.35 feet east of the transverse fracture in the east portion of the sales gas line. Chevron marks are visible and indicate that the fracture propagated to the west, towards the transverse fracture.**

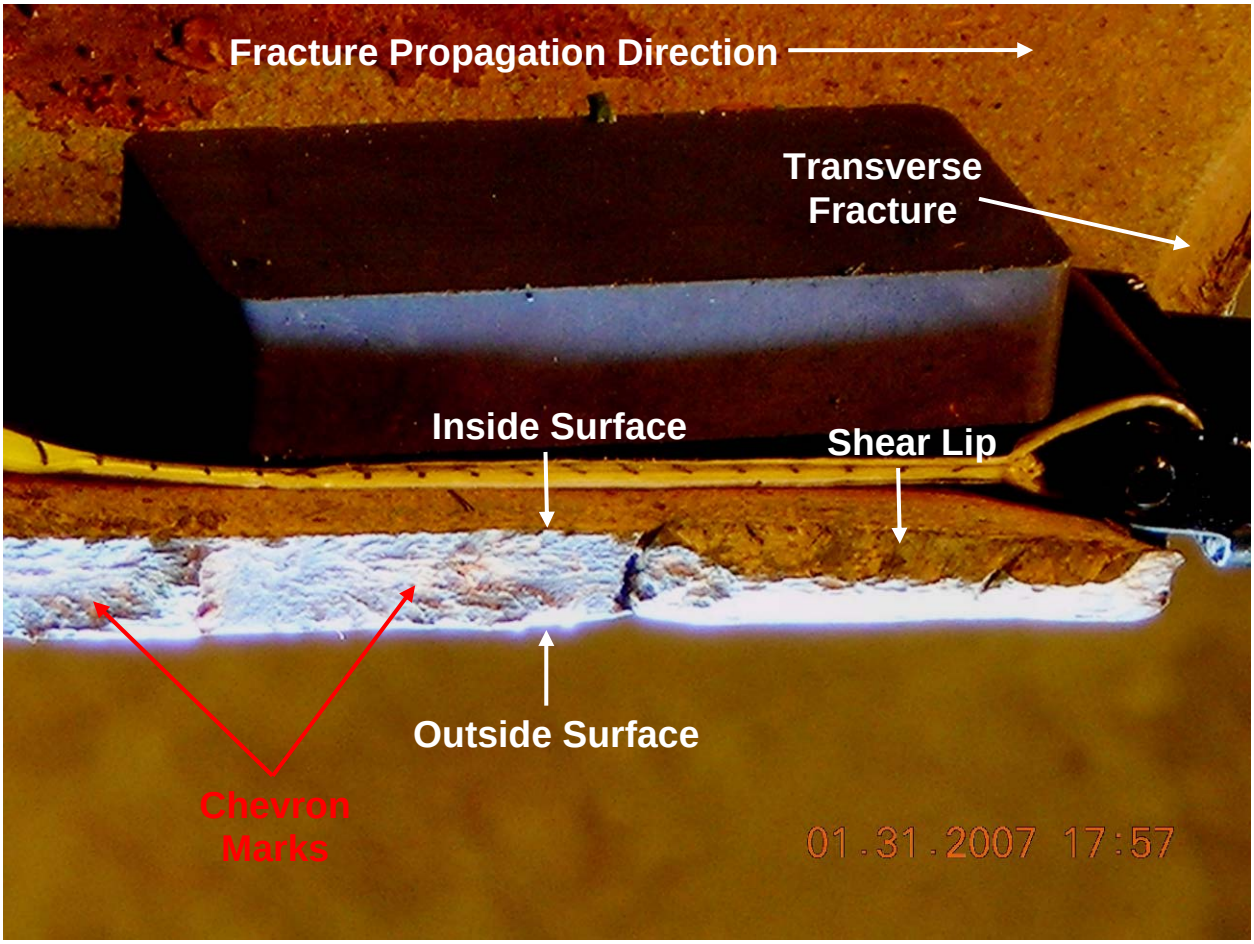

Figure 35: **Close-up view of the longitudinal fracture near its intersection with the transverse fracture in the east portion of the sales gas line. Chevron marks indicate that the fracture propagated to the west, towards the transverse fracture and away from the likely origin area at the large dent. A large shear lip is evident at the end of the longitudinal fracture.**

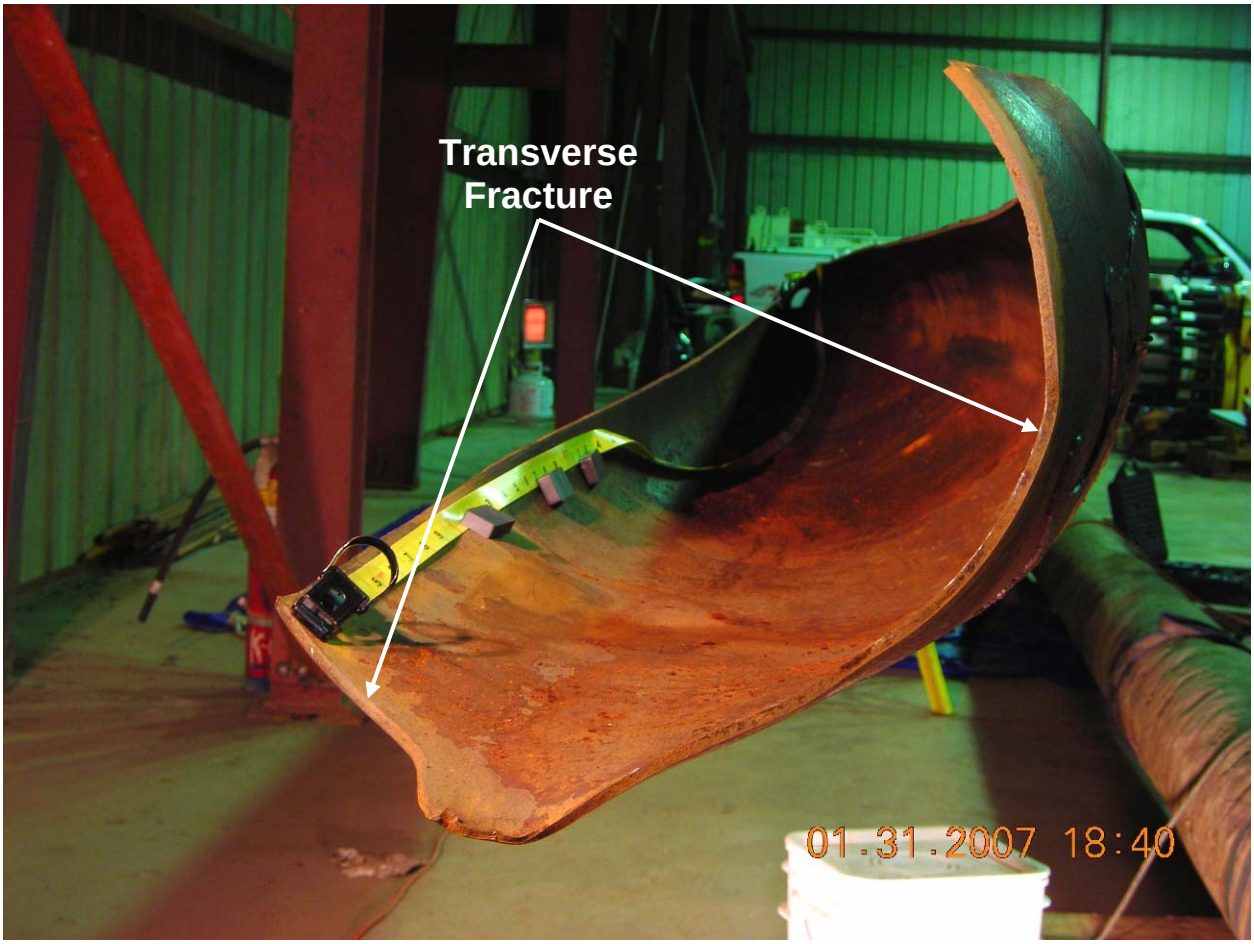

Figure 36: The transverse fracture on the west end of the east portion of the sales gas line.

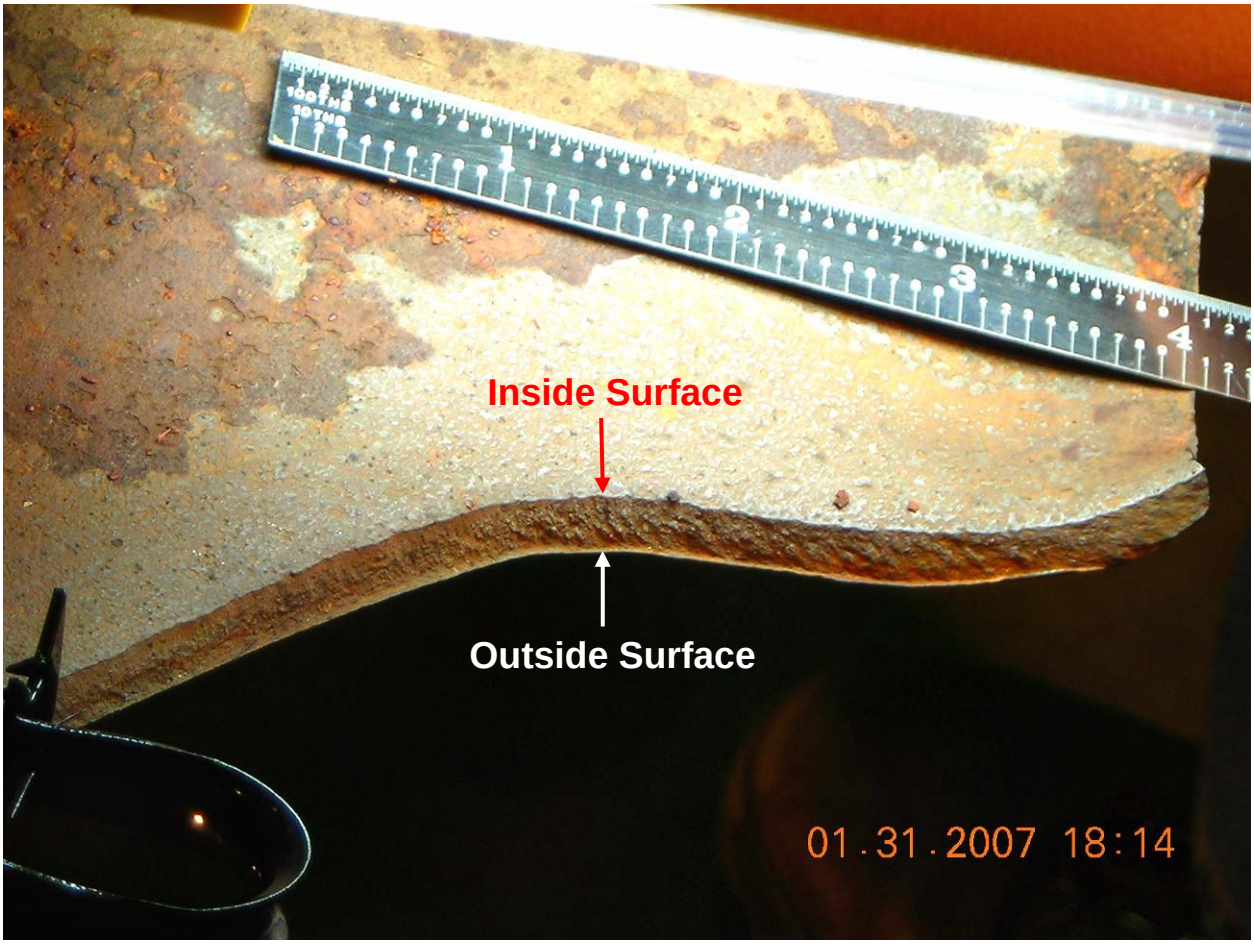

Figure 37: Close-up view of the transverse fracture surface adjacent to the longitudinal fracture in the east portion of the sales gas line.

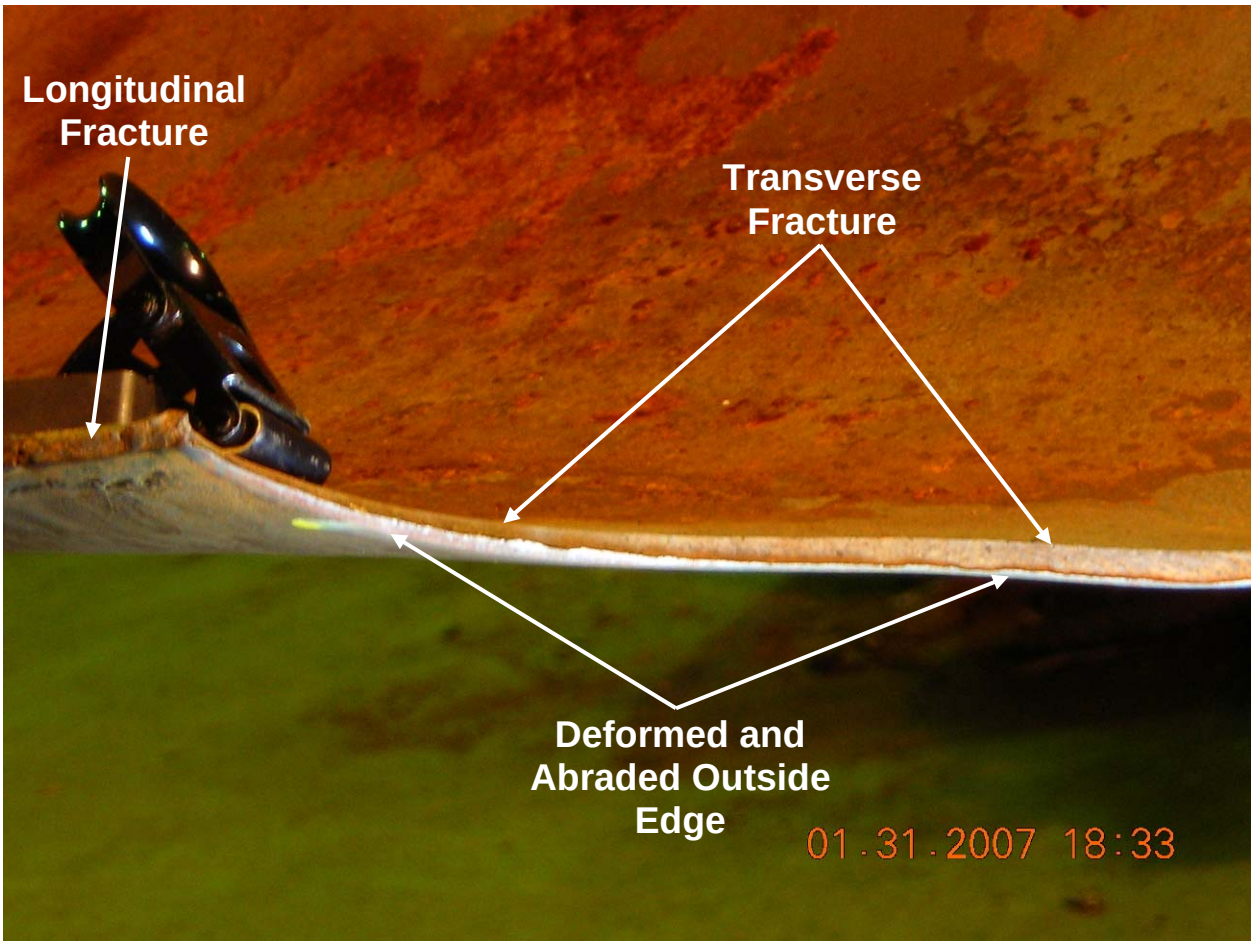

Figure 38: **The left end of the transverse fracture shown in Figure 36. Notice that the outside edge of the fracture has been deformed and abraded, apparently by impact with a foreign object, following the fracture.**

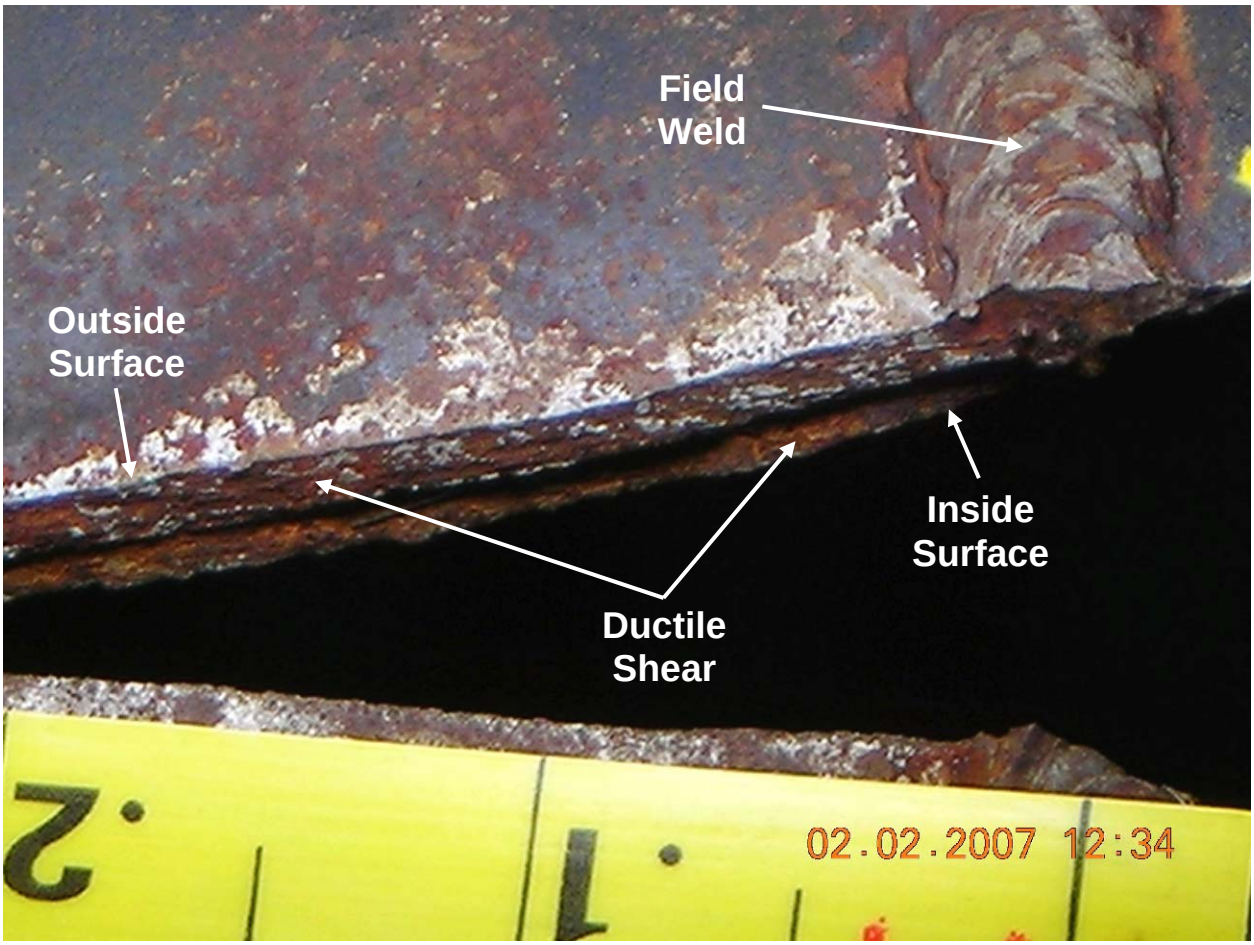

Figure 39: Close-up view of the east end of the longitudinal fracture in the east portion of the sales gas line showing ductile shear after the fracture crossed the field girth weld.

Figure 40: **The west end of the east portion of the sales gas line showing the locations of the wall thickness measurements along the longitudinal and transverse fractures.**

Figure 41: The west end of the east portion of the sales gas line showing additional locations of the wall thickness measurements along the longitudinal and transverse fractures.

Figure 42: The location of the remote wall thickness measurement near the east end of the longitudinal fracture in the east portion of the sales gas line.

Figure 43: The remote location, approximately four feet east of the transverse fracture in the east portion of the sales gas line, where hardness measurements were made.

Figure 44: Spiral-wrapped asphalt-type coating on the outside surface of the east portion of the sales gas line.

Appendix A

NTSB Letter of January 19, 2007 to Chevron USA Production Co. Requesting Nondestructive Tests and Examinations of Sales Gas Line

NTSB
National Transportation Safety Board
490 L'Enfant Plaza, SW
Washington, DC 20594-0001
www.ntsb.gov

January 19, 2007

Mr. Kerry Mire
Chevron USA Production Co.
5750 Johnson Street
Lafayette, LA 70503

Dear Mr. Mire:

In order to further the National Transportation Safety Board's investigation of the pipeline fracture, a report with the following information is required:

- Written and photographic documentation of the overall condition of the pipe and fracture locations including circumferential and longitudinal weld locations and circumferential location of the longitudinal fracture as oriented in the ground.
- Fractographic inspection documenting fracture mechanisms, fracture directions, and fracture origin(s) including written and photographic documentation.
- Written and photographic documentation of any features consistent with foreign object contact, preexisting conditions, or any other damage affecting the pipe integrity.
- Measured dimensions including wall thickness measurements near the fracture origin(s) and at other locations away from the fracture, inner diameter, and outer diameter.
- Material hardness measurements within the fractured length of pipe.
- Pipe and coating specifications.

We request that this report be provided to us by February 2, 2007. This would satisfy initial requirements, but additional examination and testing could be deemed necessary based on initial results.

Sincerely,

Matthew R. Fox, Ph.D.
Senior Materials Engineer
National Transportation Safety Board

cc: Rod Dyck